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ABSTRACT

The 1961 meeting of the Western Regional Conference on Testing Problems dealt with changes in education and measurement since Sputnik. The following papers were presented: (1) "Who's Testing Whom and for What?" by Daniel D. Feder; (2) "Recent Development and Problems in the Teaching of English" by Alfred H. Grommon; (3) "The New Foreign Language Teaching and the Need for Tests in All the Skills" by George Scherer; (4) "The Teaching of Modern Mathematics" by John L. Kelley; and (5) "Some New Science Curricula and their Measurement" by Frederick L. Ferris, Jr. A list of conference participants concludes the report. (KM)

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EDUCATIONAL TESTING SERVICE



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The Tenth Annual
WESTERN REGIONAL CONFERENCE
ON
TESTING PROBLEMS

Changes in Education and Measurement Since Sputnik

May 5, 1961
Hollywood Roosevelt Hotel
Los Angeles, California

Colonel Virgil J. O'Connor, Chairman

EDUCATIONAL TESTING SERVICE

Princeton, New Jersey

Los Angeles, California

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CONFERENCE LIST

The Tenth Annual
WESTERN REGIONAL CONFERENCE ON TESTING PROBLEMS

The tenth annual meeting of the Western Regional Conference on Testing Problems on "Changes in Education and Measurement Since Sputnik", sponsored by the Los Angeles office of the Educational Testing Service, convened at 9:15 a.m. in the Blossom Room of the Hollywood Roosevelt Hotel, Los Angeles, California, General Chairman Colonel Virgil J. O'Connor presiding.

DR. JOHN HELMICK (Director of Educational Testing Service, Los Angeles Office): I am delighted to be able to welcome all of you to the Tenth Annual Western Regional Conference on Testing Problems on behalf of the Los Angeles office of Educational Testing Service.

This is the tenth of these meetings and the fifth time I have had the pleasure of being here. Next year, if I survive, it will be six out of ten, and I will have obtained a majority. I realize that I am still very junior as far as some of you are concerned who have attended these conferences since the beginning.

We are delighted that so many people have been faithful attendants over the years. We hope we can continue to have these conferences and that they will be of the sort to continue to entice you out. We appreciate very much any comments or suggestions that you may give us as to the nature, timing, or any other features about the conference. We wish the conference to be useful to you, and the only way we can be sure is through your reactions.

As you know, a conference of this sort doesn't just happen. A great deal of work goes on, and at this time I want to express my appreciation to the entire staff of the Los Angeles office which has been involved in one way or other. Particularly, thanks are due again this year to Bob Lambert, in charge of Advisory Services, for the overall supervision, planning, and arrangements, and to Mary Owen for the details of seeing that everything is organized and working properly.

At this time I am very happy to turn the meeting over to your Chairman for the day. He will carry on from this point. Since his name is printed on the program, I guess there is nothing I can do to make it a secret by saving it until the last. Our Chairman today is Colonel Virgil J. O'Connor, Registrar of the United States Air Force Academy. Originally a Middle Westerner, he was born and reared in Waterloo, Iowa, earned a Bachelor's degree at Iowa State Teachers College, and won his Master's from the University of Michigan. He taught high school in Iowa and Michigan for about five years and then at the time of the war, his affiliation with the Air Force began. He didn't start out as a Registrar in the Air Force. In fact, he was originally a Weather Officer.

He received a Doctorate in Education from Harvard University in 1949 and has been a research psychologist since that time. Apparently Harvard marks the transition between weather and psychology. Whether weather or human nature is less predictable we will leave for him to say.

He was a Deputy Chief in the Headquarters of the United States Air Force from 1952 to 1955. Since 1955 when the institution began, he has been with the United States Air Force Academy as Registrar. Just last June he received a presidential appointment as Permanent Registrar, one of the relatively few officials at the Air Force Academy who is on the permanent staff and not subject to rotation.

I am very pleased that Colonel O'Connor has consented to be your Chairman today, and at this time I am very happy to turn the meeting over to him.

CHAIRMAN O'CONNOR: Thanks, John. I wish you had started out by at least pretending to be a friend of mine. My name is Virgil, and I go by the name of "Virg". I am going to call everyone up here by his first name. Unless we are comfortable, we won't enjoy this. From now on can we do that, including John, and will you be friends with all of us up here?

I am more than happy to be here, I assure you. Any time I can get away from Colorado this time of the year I am happy to be here, but it changes soon. Spring comes around the fourth of July. Winter doesn't start until the day after. Since there are several of us here from Colorado and I have been talking about friendship, I can't resist telling about - well, it's a good story and we always tell it to visitors.

It is about the group from the East invited to go hunting in Colorado, and the rancher who invited the group wanted to be sure they were well taken care of. He obtained the services of the best guide in the Rocky Mountain region. The guide gave the group a detailed briefing and toward the end of his harangue he demonstrated how to treat snake bite. He didn't carry any snake-bite kit but employed his pocketknife. He said, "Take out your knife. Now, you cut a little 'X' through the fang marks. Let it bleed. Suck the blood and venom out. Suck and spit, and be sure you get all the venom out of the arm." He was very effective in his demonstration. At the end of the briefing, he asked, "Have you any questions?" There was a question. "I can see how I can take care of a bite in my arm. What happens if I get bit in back?" "Mister, that's when you find out who your friends are."

I do want to assure you that we want to be comfortable up here and have some fun during this day. You are going to be sitting there a long while. I hope you will be comfortable too. There is the old story of World War II of the sergeant that called out the recruits, "Those with the college degree, two paces forward," and they marched two paces forward. "Those with the high school diploma, one pace forward." So he had three rows here, with non-graduates in the rear row. "Now, you college boys, you pick up the cigarette butts; you high school graduates, you pick up the gum wrappers; you dumb bunnies in the back row stand around and learn something."

Now, I am not going to describe the theme today. It is indeed an appropriate one... "Changes in Education and Measurement Since Sputnik".

If you were fortunate to be watching television, like I was this morning, you were indeed thrilled. We meet on a day when we can really challenge Sputnik and celebrate

with Lieutenant Commander Alan Shepard of the Navy. I hope some of the other speakers will make reference to it too. It is a great day for all of us and particularly for those Navy boys.

I have only one caution. I am going to be keeping time up here. We want to leave this room right on the dot because it has to be set up for lunch. We wish to keep the speakers to the precise time allowed. I remember being present at a College Board Colloquium where a certain speaker was more comprehensive than incisive. After we had listened for a while to his paper, one listener turned to the fellow next to me and asked, "What follows the speaker?" My neighbor answered, "Wednesday."

The first speaker I am sure many of you know because he has traveled around the country a great deal as President of the American Personnel and Guidance Association and had a hand in many other activities. Let me tell you a little bit about him. He was born in Philadelphia some years ago but came to Colorado sufficiently early in life to become a graduate of East High in Denver. He went to the University of Denver for his Bachelor's and continued there for his Master's. He was in an apparently accelerated program; he had the Bachelor's and Master's in less than four years after graduating from high school. Then he went to the great state of Iowa for the final step in his education, earning his Ph. D. from the University of Iowa. He stayed there for a time as Director of Personnel Research and then went to Illinois, working with high schools there on a state-wide testing program. He came to the University of Denver as Dean of Students and Professor of Psychology immediately after World War II. He has been at the University of Denver since 1946. I give you Dean Feder.

WHO'S TESTING WHOM AND FOR WHAT

DANIEL D. FEDER

Thank you, Virg. Good morning, colleagues. I talked earlier this morning with Virg, my friend and neighbor, about this great and thrilling occasion. Subsequently in our conversation I reminded him, too - which was probably poor timing on my part concerning the size of my manuscript - that an introduction "to be immortal need not be eternal"; and Virg, in turn, looking at the paper I had with me, said, "Well, the same could be said for the manuscript." I have been in the process ever since of trying to cut it down.

In the long perspective of world history, undoubtedly there will be a period in the development of mankind which will be referred to as the post-Sputnik era. The theme of today's Tenth Annual Conference on Testing Problems is consistent with the themes selected in many other phases of American life wherein an effort is being made to identify and appraise changes which have occurred since man's reach to outer space changed from dream to reality. So we too are concerned with "changes in education and measurement since Sputnik." One need not be a student of history, however, to realize that the gaining of adequate perspective whereby an historical trend may be traced takes considerably more than three

years. In fact, it is altogether doubtful that anything like a real trend can be claimed to have been established in so short a time.

One thing is certain. Since the advent of Sputnik, the focus on education in America has become both sharper and more extensive than at any other time in our history. The introduction of bills by President Kennedy and his administration, proposing to distribute billions of dollars for the general support of education and for the significant extension and support of the National Defense Education Act of 1958 is concrete evidence of the belief that has been so often claimed but seldom supported, namely, that an educated populace is the most secure basis upon which to build a democratic society and a free world. Thomas Jefferson once wrote, "The nation which expects to remain ignorant and free expects what never was and never will be".

We have been pecking away for many years at the fundamental principle enunciated by one of the greatest of all Americans, but now in 1961 we may witness the first truly massive, significant break-through which will lead to a more adequate support of education and the greater possibility of insuring a totally educated and enlightened populace. This is surely a post-Sputnik development of significance.

When Sputnik I went into orbit, there was a hue and cry aroused which focused on the failure of American schools and colleges to educate students in the fundamental sciences. As is so often the case, panic is followed by panaceas. Immediately after Sputnik I, a new generation of educational authorities composed of some educators, to be sure, but a goodly number of admirals and generals (both active and retired), political aspirants, and a host of others suddenly became authorities. One of the most succinct comments on this phenomenon came from Dr. John Gardner, President of the Carnegie Corporation, who observed that "Immediately after Sputnik I, a great many people who heretofore had not had two consecutive thoughts about education suddenly went into orbit and started beeping".

The burden of much of this post-Sputnik "beeping" was an attack upon the schools and colleges for their concern with "life adjustment", the "well-rounded student", "maturity", and a number of other phrases which I am sure you are equally competent to supply. The immediate implication of these critics was that the schools had no business concerning themselves with these aspects of a student's life. For them the intellectual life was the only concern.

I am not about to argue the merits of the past or the validity of these criticisms in this particular era. I believe that history will show we have had a long and vivid experience of reaction, over-reaction, and compromise in these philosophical approaches to education before Sputnik and undoubtedly will continue to have these adjustments in the years ahead. What I think is more pertinent for us in a measurement reference today is the fact that so little work has been done relative to the "life adjustment" achievements of students and their measurement. Certainly it is reasonable to suppose that if this aspect of education had been a major preoccupation of classroom teachers, considerable attention might have been devoted to the development of valid and significant measuring instruments which would appraise the student's growth and development in these dimensions. The

fact that after all these years one still has great difficulty in finding really significant instruments for measurement in this area as compared with the quality of other measuring instruments must certainly be interpreted as giving the lie to the claim that such adjustments have preoccupied the teacher beyond the essential commitment to subject matter qua subject matter. In fact there are certainly a great many of us here who would agree, I am sure, that the classroom teacher serves his best function in developing minds in relation to subject matter and may very well be treading dangerously when he branches out into the personal and life adjustments of the student.

I too would wish to express concerns about certain test developments, and mine are quite specifically related to the post-Sputnik era and some of the things that have happened in all levels of education as many test users seemed to go overboard for testing. There are some perspectives necessary for the proper evaluation of these concerns. Although significant programs for the identification of talent were under way before Sputnik, many of them did not get their full impetus until after we panicked. Wolfle's highly significant evaluation of our talent resources was conceived long before the space era. "Project Talent" was on the drawing boards and in its planning stage before either we or the Russians blasted off. In 1958, the Rockefeller Brothers Foundation report, "The Pursuit of Excellence", laid before us a host of challenges, one of the most important of which was expressed in these words: "A wasted skill, a misapplied ability is a threat to the capacity of a free people to survive". In this sentence alone one might find almost all the justification needed for the National Defense Education Act and the tremendous impetus it has given to the effort to identify talent at every level. But there is a corollary statement in this document also which needs to be borne in mind whenever we turn our attention to the identification of the talented and able student, and that too is a basic principle on which our civilization and democracy have been founded. It was expressed in these words: "Judgments of differences in talent are not judgments of differences in human worth". I propose that these two statements with their tremendous implications for education form a charter for the ensuing comments so that we do not lose sight of the individual student who still is and always was the focus of our educational efforts.

Despite criticism of minutiae, advances in the testing of aptitude and achievement have been well grounded. No longer are we confined in educational testing to the reproductive memory challenge which characterized TV shows of a few years ago and which, as carefully noted by the announcer, is still the major characteristic of the well known College Bowl program. We can successfully and demonstrably measure the ability to reason with given facts, the ability to make inferences from data, and the ability to integrate knowledge from several sources in problem-solving situations. To be sure, none of us would argue that these alone are the full measure of an individual's achievement or future learning capacity. We have even begun to probe into the more meaningful aspects of personality and made efforts to evaluate the total personality as a functioning entity.

Despite these advances there are still many people outside our professional ranks opposed to the use of any kind of tests and measurements, largely either because they don't understand them or because in some way personal toes have been stepped upon in the course of a testing program. For example, in a large city school

system about three years ago a virulent attack was launched against the entire program of testing aptitude and achievement, spearheaded by one mother whose son had been found seriously deficient in both achievement and aptitude and was accordingly placed in sections for retarded children. The affront was sufficient to stimulate the attack upon every effort the school system was making in the direction of better adaptation of its methods to individual student needs.

Witness also the diatribe against the College Entrance Examination Board which appeared in an issue of Commentary last year. The Board, in reply, presented the data on a study in which a group of high level admissions officers and college deans made predictions about students' achievements in college, using all of the non-objective data that they normally had at their disposal, and the results were pretty miserable as compared with the predictions obtained by the use of some of the College Board examinations.

It seems safe to predict that the tremendous impetus given to testing programs for the evaluation of individual students during the past three years under the influence of the National Defense Education Act of 1958, itself unquestionably spurred by reaction to Sputnik, will be reflected in a widespread common acceptance of this type of testing program as an essential part of any school's operation. What is perhaps not so clear yet in this area are the inherent dangers and naivete which accompany the uncritically enthusiastic tendency of us Americans to hop onto any attractive bandwagon and go along for the ride without knowing or attempting to foresee the end goal. I would not for a moment suggest that we should neglect the technical imperfections of some of the tests offered on the market daily. But in actuality we ought to be more concerned with the greater and more significant imperfections in the test users rather than with imperfections in the tests.

Under the sponsorship of the American Association for the Advancement of Science, a group of leading test technicians met in Ann Arbor, Michigan, almost exactly three years ago. With the impetus of the N. D. E. A. of 1958 already behind them and the rapidly developing national and state scholarship programs on all sides, the committee addressed itself to the role of tests in state-wide counseling and scholarship award programs. The committee enunciated three general principles to govern the choice and scheduling of aptitude measures:

- "1. The choice, timing, and use of aptitude measures should be planned so as to supplement as effectively as possible the information provided by measures of achievement.
2. Information provided by measures of achievement should be reasonably current at the time of its most critical use.
3. Any school-wide testing program should be supplemented by additional individual testing as determined by the special problems presented by the individual case."

Note in these principles the recognition of the fact that the achievement testing program is inherently more significant to the school system and hence more basic in the service of its needs than other testing programs. Beyond this was the recognition of the principle mentioned earlier that an effective measure of achievement is still one of our best predictors of future performance.

The committee went on to recommend that a scholastic aptitude test should be given at the sixth or seventh grade level, designed to yield scores based on verbal and quantitative materials. It next recommended a test of essentially the same sort to be given at the eighth or ninth grade level approximately two years later. Its third recommendation was for a comprehensive test of academic ability to be given in the tenth or eleventh grade. This test was seen as one that could be useful in identifying students eligible for later scholarship competitions, to make certain that all students with college level ability would be encouraged to plan for college and undertake study programs to meet college entrance requirements, and also to be used by counselors in assisting the student in choice of college or other post-high school education. A fourth recommendation included a vocationally oriented aptitude battery for the eleventh or twelfth grade, particularly for those who were not planning to go to college.

The foregoing recommendations of a minimum essentials program took account of the school's needs for the evaluation of achievement as well as for the individual's needs for information upon which to make his important life choices. Lest the orientation and attitude of this committee of test experts be misunderstood, let me hasten to add that they recommended five categories for data collection and a schedule for each beyond the objective testing program just outlined. These included a biographical data folder, interests as measured by tests and other devices, personality testing, parental interviews, and teacher appraisals. The importance of these latter data must not be overlooked, although our focus today is on the field of testing.

It would be interesting indeed to attempt a thorough-going census of school practices around the country in the light of the foregoing recommendations. Through association with a number of scholarship programs as well as with the admissions operations of my own University, I have the opportunity to see literally thousands of student reports each year. In many school systems the conventional transcript is no longer adequate for the reporting of test scores. Instead, one-, two-, or three-page mimeographed profile sheets accompany a transcript of grades. In numerous instances these reports reflect the fact that multiple testing of the same characteristics is being done either on the same day or a few weeks apart. Oftentimes the profile will reflect only achievement tests or only aptitude tests. Whether or not both sets of data may be available at the school itself is not evident from what is provided on the profile. To the counselor, the admissions officer, or anyone else concerned with the identification of operational talent, a series of scores at the eleventh grade median for an eleventh grade student on the Sequential Tests of Educational Progress will have one set of meanings if the student's academic potential as measured by an equally valid test of aptitude also places him at the median of his class. But if the potential is in the top ten per cent and the achievement is at the median, the scores indeed have quite a different meaning in reflecting the motivation, application, and earned increment which the student is carrying away from his educational experience. The basic principle to be observed here is that the testing program must be so constructed, not only to differentiate one student from another, but also to make possible differential appraisals within the student himself. Obviously the challenge to both counselor and teacher rests in the stimulation of the student to the optimum achievement of which he is capable as demonstrated by valid measurement of his potentials.

Test makers have devised a varied and interesting series of methods for the reporting of test scores. In the three years plus since Sputnik, little has been done to eradicate the IQ from common parlance in testing situations despite the emotional and unrealistic thinking which has characterized this concept. Efforts to substitute percentile scores and standard scores have made inroads but have been resisted because they are both more mysterious and more difficult to comprehend by lay persons. A notable advance in test realism was made with the introduction of the concept of the percentile band when the School and College Ability Tests were placed on the market. This was a frank, honest and realistic recognition by the test makers of the concept of variability of a test score and the necessity of interpreting it within a band range which would encompass probabilities of any given score being the "true" score for an individual student. Here the test makers have made the effort to guide the test users to enlightened and accurate methods of interpretation but the plain fact is that little is known yet about the best way in which to report test scores.

One is tempted to raise the question as to whether, for counseling and educational evaluative purposes, we actually need more than four or five categories into which to classify students by means of test scores instead of focusing with so much assurance and exactitude upon numbers whose absolute reliability is not in any way assured except as they may be the result of repeating testings over a number of years. Obviously, for research and statistical purposes, numbers still are necessary. But it is of questionable validity to make discrimination between two students on the basis of a twenty-five point difference on a College Entrance Examination Board test where the score difference may be the result of a performance difference of only three or four items. If one wishes to push this analysis still further and question how the classroom teacher, using generally even cruder instruments than those we are concerned with here, can justify a numerical grade for one student of 92 and for another of 93 and prove that there is an actual difference, perhaps all I can say in reply is, "How naive can we be?"

Although I have actually tried to encapsulate a number of specific points and deal with them as entities, there is in fact an essential inter-correlation among all of these matters under discussion. There is no gainsaying the fact that there is available today more information of an objective and reliable nature concerning the aptitudes and achievements of students at all levels of education than has ever before existed in our history. In addition to internal school testing programs, there are now state-wide and national testing programs, all returning results to the schools and all having certain common motivation - the identification and stimulation of students of all levels of ability to the maximum achievement of which they are capable. This proliferation of programs and multiplication of available data is not the child of Sputnik though it be essentially a post-Sputnik phenomenon. A number of state and national programs existed long before.

Certainly the national testing programs sponsored by the College Entrance Examination Board, the Educational Testing Service, the Psychological Corporation and other similar agencies were under way many years before the realities of space travel. But their essential purposes were much the same at inception as they are now.

The challenge to identify and stimulate able students raises the interesting question, "By what means?" If the student is never apprised of his potential, then to what extent can he be motivated to use it? If the information lies fallow in the files of the school or in the counselor's office, who is testing whom and for what purpose?

The time for secrecy is long since past. It should be needless to point out that at all levels of education the schools and school staffs, the students, the parents, and all concerned are in a most intimate partnership which can operate effectively only as the partners treat each other with candor and integrity. On this point the testing leaders at Ann Arbor said, "The forthright interpretation of test results, properly related to other available data, should be made to the pupil, his parents, and his teachers. Care should be exercised, however, that the test data are not over-emphasized. It is important that results be interpreted and not merely reported."

If there is a purpose in giving a test of any kind, if there is a purpose in collecting data of any kind, then certainly the most essential purpose is that of sharing the information gained thereby with those who have the greatest concern, and in this I include students, parents, teachers, and others who may rightfully have reason to use the information in the student's behalf. To the objections and fears that test data may be misused by persons who are not fully sophisticated in the interpretation of their meanings, the only answer is that it is the responsibility of those of us who introduce these tests into the school program to make sure that those who have a right to the data are educated in their proper interpretation. In truth, it might be more valuable as part of the teacher preparation program to expose the potential future young teacher to a course in the appropriate use and interpretation of tests and measurements in place of part of the busy work which characterizes some of the courses now required for teacher certificates. Education has moved forward dramatically and drastically in the last few years in both philosophy and practice, but teacher certification requirements have not kept pace.

During the past few months a school system in this general geographic area came under fire for certain of its testing practices. Pertinent to our present discussion was the discovery by an investigating committee that an elaborate testing program had been undertaken without any preconceived notion of what the program was designed to do or what its ultimate objectives would be. One wonders to what extent this kind of rather random testing has become prevalent through the availability of N. D. E. A. funds. Testing for the sake of testing alone is as naive and fruitless as the ignorance-based or prejudice-based total rejection of tests. Delineation of the objectives of the testing program is a first requisite. Only in such terms can intelligent selection of tests be made. The culminating goal of the program must be the interpretation of the results to those who have a real and vested interest and are entitled to such information, because it is only in terms of such practices that the evaluative, predictive, and stimulative objectives of the testing program can be accomplished. Continuing, meaningful reports of results to the supportive community are an inherent part of this planning.

In recent months a number of professional associations have concerned themselves with the multiplicity of national testing programs which seem to have common objectives. An effort to evaluate school reactions to the inherent problems was made

recently. It is altogether intriguing to note that two separate investigators, both reputable and competent, came up with quite opposite conclusions from their analyses of common data. Actually, the national testing program does not require released time from ordinary class duties. The internal, local testing program, on the other hand, does take the students out of normal classroom activity and in some cases for many hours in the course of a school year. Oftentimes the two programs provide very much the same kind of data concerning the student, with no great enhancement of the overall picture being provided by the duplication. Having literally covered the nation during the past year in a series of meetings with counseling groups in many different states and areas, I feel that, far from being the imposition which some have claimed, the national program does less to interfere with school procedures than do many of the internal local programs. What is far more discouraging in this respect is the fact that altogether too few of our schools and colleges are using the data available to them either for understanding the student himself or for helping the student to a better self-understanding; and lack of staff in adequate numbers is not the only conditioning factor.

Although I cannot document this next observation with a survey of facts and numbers, I am nevertheless quite convinced that the old threat which national and standardized testing programs used to pose as a restrictive influence on curriculum development has pretty well disappeared. The impetus which has been given to curriculum development through the work of the College Entrance Examination Board and the Educational Testing Service, as a case in point, and the correlated developments in improved examination methods have indeed operated as a stimulus to classroom teachers to re-evaluate and reconstruct curricula in many subject-matter areas.

As recently as a decade ago one heard many concerns expressed about the possible restrictive influences that would be imposed upon teachers when their students would be tested by external, objective measurements. To be sure, there are some areas in which these concerns are still voiced because programs have been narrowly conceived. But on the whole, with the tremendous improvement in measurement methods which has been achieved in the past few years, many teachers find themselves challenged to a higher level of instruction and have more significant guides to content than they have had before as they strive to meet the standards set by well-conceived and well-constructed examinations. In truth, many of our best standardized examinations are extending the frontiers of curriculum and teaching methods and posing challenges rather than imposing restrictions. There is evidence to suggest that we are doing a better job of measuring the student's ability to integrate, apply, and make inferences from his learning than we are in the actual teaching of the processes involved.

These remarks opened with the notation that this is a conference on testing problems. The essential focus to which we are to address ourselves is in the realm of developments resulting from the impact of, or at least since the impact of, Sputnik. Judging from the titles of the talks which are to follow, we will be treated to reviews of recent experiments and developments in teaching and testing in English, mathematics, foreign languages, and the sciences. Even the casual student of developments in these areas must know that totally new concepts of subject matter depth and quality are being probed and developed at several levels of education.

From my perspective there are problems, not only in the technical development of tests themselves, but even more significantly in the uses to which the tests are put and the persons who are using them. I see these as continuing challenges, not merely as problems for which some ready solutions will be found. Certainly there is no reason to expect, in a field as dynamic as education is or ought to be, that static solutions are a possibility. Rather it is more likely that new solutions within themselves will create or expose additional problems.

Although we have maximized the predictive efficiency of many of our test instruments as used in the present structure of educational evaluation, the obtained correlations leave much to be desired for individual predictive efficiency. Obviously there are still unmeasured elements in the individual learner as well as in the learning process which require much further study. I hesitate to predict how long we shall be beset with IQ's of doubtful meaning and little comparability. We need to give attention to new and more meaningful ways of reporting test scores so that they may be more readily interpreted and understood by counselors, teachers, students, and parents alike. The need for such an experimental study becomes all the more urgent as we face the prospect of tremendous increases in enrollments at all levels of education and an equally tremendous shortage of qualified personnel to provide the individualized kind of interpretative service which is an essential part of any testing program. As we look more and more to possible mechanical devices and means whereby students may intelligently interpret their own scores and come to better understanding of themselves, it will become increasingly important to have available simple, standard, but universally meaningful interpretation methods. Standardization of terminology is a characteristic of maturity in any science. In the science of measurement we need to grow up in this regard. Using tests wisely and well is a prime requirement in program planning and ultimate program culmination.

All too often the student is seen as a profile of tests translated into some kind of scores which enable us to compare one aspect of his development with another but oftentimes each without reference to the totality of his person. The challenge to the test user is that of seeing the student as a total human being and not as a test profile. The challenge is to appraise the student as a functioning entity in which the test profile is merely one device for contributing to his understanding and appraisal of himself rather than the total global description of the student as a vital human being. Although biographical data, anecdotal records, interest, and personality descriptions are not the central subject of today's discussion, nevertheless they are part and parcel of the testing problem.

Test users must become knowledgeable in how to relate test-derived information to other student data which permit the description of the total personality and are integral to our understanding and appraisal of the student. In addition, it is important that we do not oversell the advantages that accrue from testing. It is distinctly more dangerous to oversell the value of tests than it is to undersell them.

The support of testing programs under the National Defense Education Act must be used wisely and with careful interpretation to the community elements who have made the effort possible. The indiscriminate use of tests, the failure to plan

programs carefully in terms of ultimate use, and the often implied assumption that the tests are ends in themselves may produce expectancies which we cannot fulfill. In the light of such failures, we may witness the loss of all the good we would accomplish by virtue of our inability to compensate for some of the evils unwittingly introduced to the programs.

Fully as much as Sputnik and Explorer, and now Mercury, a lot of us have gone into orbit in the past three years and have become test-happy rather than test-wise. We search every new test as though it may have in it the panacea for every educational ill. Yet the basic fact remains that we are far from having exhausted the potential information available to us in many of our existing tests if we but know how to read all of the signs of the student's performance on them.

I do not know the name of the sage who observed that, "Nothing seems as long to man as life when he is beginning it nor nothing so short as life when he is ending it." I find myself precisely in this position at this moment. At the outset it seemed as though there would be far more time than needed to reflect upon the simple questions of who is testing nowadays, whom we are testing, and what our purposes in testing are. Suddenly I find myself with so much more that ought to be said and hoped for against the inexorable march of time. If I have read the trends right, the evaluation of human abilities and achievements will in the next decade become a central focus of all concerned in the preservation and utilization of what is our most precious natural resource--an educated and enlightened citizenry.

CHAIRMAN O'CONNOR: Very fine, Dan. That was great. In addition, thank you for staying within the time limit. It does give us a chance for some questions.

Now this is your opportunity to get into the conference. Every questioner will have his question recorded. Because of that, I want to be sure that when you do get up to ask a question, you give your name, position, and place so that we can record it. Do we have a question for Dean Feder?

MR. JOHN W. McDANIEL (Vice President, Instruction, San Bernardino Valley College, San Bernardino, California): I am concerned with one of the very fine early statements that Dean Feder made, "Judgments of differences in talent are not judgments of differences in human worth." Do you think we have made any progress in this dimension?

DEAN FEDER: I wish I could take credit for the uniqueness of the words. I cannot. I can only say I have shared the thought many times. These words, as you recall, were a quotation from the Rockefeller Report. My insistence and continuing repetition of that statement--and I will repeat it whenever I am given a chance--stems from the fact that there has been a very serious tendency to misinterpret some of the intent of the language of the National Defense Education Act and also to misinterpret the entire trend toward the measurement of talent or the measurement of ability. The great danger which I perceive here is that in our reaction and over-reaction tendencies, we may find ourselves certainly trying to stimulate the superior student, something which we have needed to do and have really just begun to do in the last few years; but we are also in the process then of relegating the average

or less-than-average student to some other much less acceptable status in life. This I believe would be a violation of the Jeffersonian principle of man's equality in the eyes of God.

One could go on with this. The whole emphasis of the comments of Rickover and even some of the implications of Conant's recommendations seems to me to point in this same direction. If the student is not talented, if he is not able to move on to college and through college, perhaps on into graduate work, then we relegate him to something less worthy, and essentially to a sort of vocational peonage. This I think is a dangerous element and I defy it. That is also why I think we need to keep the words ever present, ever foremost in our kind of society, "The judgments of differences in talent are not judgments in differences of human worth."

MR. SAMUEL KAVRUCK (Specialist, Testing Programs, Guidance, Counseling, and Testing Section, U. S. Department of Health, Education, and Welfare, Office of Education, Washington 6, D. C.): Now, I'd like to mention to Dean Feder that this problem of how best to interpret the test scores has been a great concern, particularly one of our specialties. Dr. McLaughlin of People Appraisal Section has recently tried to make it known that we would like more information about this important problem; and I think we can all agree that the answer will come, not from the test makers, but from the people like those here now, the people who are to actually interpret the scores, not the parents and pupils. I wonder if I might ask each of you here to inform us in the event he has developed methods of interpreting which he feels are perhaps new and productive. We will try to collect them and feed them back to everyone. Thank you.

CHAIRMAN O'CONNOR: I feel that we should proceed. If you have additional questions for Dean Feder, you may ask them later.

I want to tell you about a pre-Sputnik experiment in Iowa. Dean Feder and others will remember Professor Seashore who was one of the originators of aptitude testing, particularly musical aptitude. I recall vividly an experiment in the town of Leando in Southern Iowa. There is a little town of Douds on one side of the Des Moines River and opposite it, Leando. These two towns were always competing in various ways, particularly where their brass bands were concerned. Well, finally Leando got a tuba, the biggest one seen up to that time. A tuba for their brass band so as to outdo Douds. Then, they had the job of finding someone to play the tuba, and having heard of Dr. Seashore and his testing experiments they decided they would measure aptitude for tuba playing.

It was a good experiment. Many tried and many failed the aptitude test; and they eventually got around to the blacksmith who wished to have his aptitude for tuba playing measured. They had only three items in the test but it was a fairly valid test--fair face validity, at least. The first question put was very simple, "Can you carry a tune?" The blacksmith whistled "Dixie" to prove his adequacy.

He then was asked, "Do you have the strength for tuba playing?" He picked up the anvil by the horn and swung it over his head.

Third, "Do you have the wind for it?" And the poor blacksmith didn't know how to demonstrate, until just then the Minister came trotting up on a little old gray mare. As he was tying her up to the blacksmith's shop, the blacksmith's eyes brightened and he was able to demonstrate his tuba aptitude. He walked over to that little old gray mare, lifted up her tail and blew the bit right out of her mouth.

Now, we have heard the only presentation with the word "testing" in it. I am sure all of the following speakers will use the word, too; but, as a preliminary to the ones to follow, I would like to call your attention to an item, a very recent item, in the newspaper. Perhaps some of you have read it but I want to be sure all of you know of it. It was in regard to an "Opinion Poll" by the Institute of Student Opinion. There was the question: "Should the American high school place more, less, or the same, emphasis on the following subjects: agriculture, commercial courses, English, foreign languages, home economics, mathematics, music and visual arts, physical education, science, shop, or social studies?" The results were interesting. We don't always realize how much these youngsters are willing to do or what they really want to do.

Here are the results for the boys who answered the "Opinion Poll": 75 per cent wanted more emphasis on science; 73 per cent, on mathematics; 62 per cent, on foreign languages; and 51 per cent--more than half of the boys--wanted more emphasis on English.

Here are the results for the girls: 68 per cent wanted more emphasis on foreign languages; 65 per cent, on science; 61 per cent, on English; 60 per cent--almost the same--wanted more emphasis on mathematics.

I could go down the whole list, but those were the ones emphasized most by the students. Of course, there were some that wanted less. Twenty-six per cent of the boys wanted less emphasis on music and the visual arts. Of the girls, 19 per cent wanted less emphasis on shop. That's fair enough. The percentages for more emphasis do illustrate rather remarkably that our youngsters want a lot more than they are getting in what we usually call the tough subject-matter areas.

The next presentation this morning is by one of your neighbors from the North. However, Professor Alfred Grommon came from the East as so many of us have. His graduate work was done at Cornell and that institution granted him a Ph. D. in English. Professor Grommon, like so many of us here at the table, has been a high school teacher. He has been at Stanford since 1945 and for six years was Director of the Freshman English courses. For some time he has been Associate Director of the Commission on the English Curriculum of the National Council of Teachers of English. At the University he is an Associate Professor of Education and English. Al Grommon.

RECENT DEVELOPMENTS AND PROBLEMS IN THE TEACHING OF ENGLISH

ALFRED H. GROMMON

Thank you, Virg. I do have a few bits to utter but I hope to do it all by myself.

However, if I prove unable to do so I will seek assistance from you because I am sure that you have been, not only a registrar, a high school teacher, and a meteorologist, but a blacksmith as well. Being associated here with the gentleman from Colorado reminds me of what I saw on campus the other day. Some student with a car from Colorado had a sign on the back, much like signs on cars from Texas, "Made in Texas by Texans." However, this fellow from Colorado, probably in rebellion against such things, had a sign which stated, "This car wasn't made by anybody."

I should like to talk for a few minutes about some recent developments and problems in the teaching of English and, as Dean Feder mentioned, this morning's news colors my opening comments, too; but what I have written is this:

Russia certainly deserves credit for her scientific and technological achievements in putting the first satellite in orbit on October 4, 1957, and for putting Yuri on his cosmic merry-go-round in early April. But we cannot let them claim credit also for such achievements as inventing the game of basketball and for what is now happening in the teaching of English in our elementary and secondary schools. To be sure, shock waves of that October orbiting affected, at least temporarily, teachers and pupils in fields other than science and mathematics. Yet to suggest, even by a handy cliché, that significant educational developments may have been launched here in the wake of Sputnik would be a disservice to the many people responsible for important programs and developments begun decades ago.

But probably red-faced America has indirectly colored somewhat the present teaching of English. Parents, school board members, administrators, college professors, legislators, newspaper editors and columnists, and English teachers themselves are now taking a sterner look at what is going on in the public schools. Many of these people, however, seem motivated also by several other forces more noticeably affecting their families, their children, and their teachers right now.

Yet in my many visits to English classes in junior and senior high schools, in my working with many student teachers and, as a curriculum consultant, with departments of English and school districts, I see no evidence of any revolutionary change in many pupils' attitudes toward the importance of English. The significant exception, of course, is the encouraging attitudes among the best students. What I have to say about developments in the field of English suggests that teachers are busy striving to improve their programs and performances, but I am not yet prepared to grant that any comparable deep commitment to the importance of English exists among the majority of students in secondary schools.

I should like to comment briefly upon developments in curricula for English classes, in co-ordinating programs of the elementary and secondary schools with those of the colleges, and in the teaching of grammar, usage, composition, and literature. I am not implying, however, that these examples represent the views and efforts of thousands of teachers of English who seem either unaware of these trends or indifferent to them. Nevertheless, in many communities, large and small, encouraging work is going on.

As to the first development: for at least the past quarter of a century, departments of English in junior and senior high schools have been trying to create sensible curricula and curriculum guides based upon research and published reports of effective practices. These publications have helped teachers take into account research on the characteristics and needs of adolescents, to relate English to their lives, accommodate the wide range of individual differences, develop thematic units for the teaching of literature, and use a variety of materials and activities suited to the diverse abilities, interests, backgrounds, and purposes of pupils who are required to study English throughout the junior and senior high schools. They have also urged teachers to co-ordinate English programs throughout the elementary and secondary schools and with those in the colleges.

The second, a more recent plan for co-ordinating programs in the schools with those in the colleges and for grouping pupils on the basis of special abilities and interests, is the Advanced Placement Program. This important development grew out of the recommendations in the report, General Education in School and College, prepared by representatives of the faculties of Andover, Exeter, Lawrenceville, Harvard, Princeton, and Yale, and published by the Harvard University Press in 1952. This group sought some way of co-ordinating programs in secondary schools and colleges so that able students might not only avoid repeating in college what they had already studied in school but also get college credit and/or advanced placement for superior preparation. The group's recommendations were first applied and developed by The School and College Study of Admission with Advanced Standing, whose program of classes and national examinations began on a modest scale in 1953. Shortly thereafter, the direction of the plan was assumed by the College Entrance Examination Board, whose officers had already helped the School and College Study group initiate its plan of admission with advanced standing. This plan has significantly strengthened English programs in a rapidly increasing number of public and independent high schools throughout the country, has improved co-ordination of these English courses with those in colleges and universities, and has helped improve the quality of teaching not only in Advanced Placement English classes, but also in other related English classes.

In 1953 only seven pilot public and independent schools began offering advanced courses. Eleven other schools agreed to present candidates for examinations in May, 1954. Twelve colleges offered to consider for advanced standing these candidates prepared in accordance with the recommendations for the program. In 1953-54 these 18 schools presented 532 candidates who took 959 examinations and enrolled in 94 colleges that fall. In 1959, 890 schools presented 10,531 students who took 14,158 examinations and later enrolled in 567 colleges and universities. Examinations are available in eleven subjects commonly taught in schools and in the first year of college. Each year, however, about 40 per cent of the examinations are in English.

This program represents a major effort to improve the quality of English courses and instruction in secondary schools. But I think it is also an effective means of stimulating capable students to make the most of their academic abilities and of advancing their high school and college studies. By its pervasive effect upon the intellectual atmosphere of the school, it is one of the most potent weapons for

combating many high-school students' educational apathy and even outright resistance to learning. Even though the participation has increased dramatically from 18 schools in 1953 to 890 in 1959, the total is still relatively insignificant when compared to the potential in the 26,000 secondary schools in the country.

The third development, a somewhat related plan designed to improve the preparation of students for college English, is that of the English Commission of the College Board. This Commission will try to improve students' preparation for college English by retraining selected teachers of secondary-school teachers by means of summer institutes on twenty campuses beginning in 1962 and by publishing syllabi suggested for classes designed for college preparatory students. The effects will not begin to be noticeable, however, until sometime after the 1962-63 school year.

A fourth factor affecting English programs in California public secondary schools is the voluntary system of accreditation for high schools established by the California Association of Secondary School Principals. To qualify for this service, a district must have written courses of study. Because many schools in California do not now have courses of study or curriculum guides, the English teachers in many districts presently are constructing courses and guides. In some schools, these new guides, including courses and materials for Advanced Placement English, are noticeably affecting the quality of instruction.

A fifth development is the increasing use of flexible scheduling of classes, and a sixth is the growing use of team teaching among teachers of English.

The final development to be mentioned here is the report on the status of the profession of teaching English, The National Interest and the Teaching of English, published by the National Council of Teachers of English. This report was prepared to inform the nation and particularly the Congress of the United States on the status of the profession and on the importance of national support for the preparation of teachers. It has been enthusiastically received by the press. In time it will affect the preparation of teachers of English and the quality of the English programs and teaching in the schools. One grave national problem is the inadequate supply of teachers prepared to teach English. According to this report, only 40 to 60 per cent of the teachers of high-school English have completed college majors in English. Let me focus this statistic on California. I don't have recent figures on this problem. But the Principals' October Report of 1955 was on the teaching of English in the junior and senior high schools in California. The figures reported at that time on the preparation of teachers assigned English classes indicate that in 1955 approximately 250,000 students in California public junior and senior high schools were taught English by teachers who had neither a major nor a minor in college English.

Other forces are also having encouraging effects. The increasing percentages of high-school graduates entering college have put pressure upon some pupils enrolled in English classes. Some teachers are assigning more papers to be written and more material to be read. Probably all are trying to find time to read

pupils' compositions more carefully. Educational Testing Service's pioneering development of lay-reader programs has helped many school districts throughout the country provide English teachers with competent help in evaluating students' writing. Reports on college students' reading habits have awakened some teachers to the importance of their responsibility of helping students become lifetime readers of books.

School boards' willingness to face facts and to take action - expensive action - is an important factor affecting the teaching of English. For example, in 1958, the New York City Board of Education decreed that no pupil retarded two or more years in reading ability was to be promoted. Automatic promotion was abolished. The delayed consequence of that action is now becoming painfully apparent. On April 14, 1961, Dr. John J. Theobald, Superintendent of Schools, reported to the Board of Estimate when he presented his budget for the city's schools for next year, saying that "67,067 of the city's 172,000 junior high school pupils were more than two years behind in reading... 10,000 seventh-graders cannot read third-grade books... 15,000 elementary school pupils were in danger of not being promoted this term because of reading difficulties." Then Dr. Theobald requested \$3,000,000 to hire 560 remedial reading teachers. He didn't say where he is going to find these teachers. But he did state that "the cost of having 15,000 elementary pupils repeat a year of schooling would come to nearly \$8,000,000."

Here is indeed a courageous confrontation illustrating school boards' and administrators' toughening frame of mind toward public education, a frame of mind that presumably is also strengthening some English teachers' resolve to hold pupils to higher standards of performance. The evidence emerging from New York City's expanding program called Higher Horizons and that reported by Martin Mayer in his article, "The Good Slum Schools," published in Harper's Magazine, April, 1961, challenge the validity of my earlier statement about many students' indifferent attitude toward the learning schools offer. I hoped to be proved wrong.

But what are some of the specific recent developments in various aspects of the teaching of secondary-school English? One major development, especially since World War II, is the teaching of descriptive modern English grammar to supplement valid aspects of conventional grammar or, in some cases, to replace it entirely. Linguistic analysis of the structure of language has a long history. But English teachers in our secondary schools became aware of it after the appearance of Charles Fries' The Structure of English in 1952 and Paul Roberts' Patterns of English in 1956. So far, Roberts' book is the only high-school text based entirely upon structural linguistics applicable to secondary-school English classes. Many articles on the nature of descriptive grammar and teachers' use of it appear regularly in The English Journal and College English, journals that are read by about 50,000 teachers of English throughout the country. Yet according to Harold Allen's recent survey reported in the National Council's report, The National Interest and the Teaching of English, only about 17 per cent of the institutions preparing teachers of English require candidates to study modern English grammar. Teachers of English in secondary schools and colleges who presumably have scholarly attitudes toward other aspects of English resist accepting the ever-increasing knowledge about our language reported by linguisticians and structural grammarians. As

W. Nelson Francis has said, "Here is a cultural lag of major proportion." But the number of teachers using these findings is gradually increasing, and more textbooks are being prepared.

Even though these usable aspects of conventional grammar and of structural and transformational analyses will give pupils a valid concept of how their language functions in conveying meaningful utterances, we still don't know how much this knowledge actually helps us speak and write effectively. One modest research project at Coral Gables High School in Florida reports that the teachers' use of modern English grammar did help the experimental classes improve their ability to write compositions more than did the use of conventional grammar help pupils in the control classes; but the evidence is far too limited. Yet a start has been made in testing the relationship of a knowledge of structural grammar to ability to write. One major difficulty in our measuring how much students know about their language is that we have no tests that I know of designed to examine pupils' knowledge of structural aspects of the English language.

A second controversial development, started at least as early as the 1930's, is the questioning of the validity of the concept of so-called correctness of expression. Many teachers - not all, of course - recognize the growing evidence that standards of acceptable English vary from class to class and from one section of the country to another. Research on the English actually used by educated, cultured Americans in various regions of the country has reported evidence refuting much contained in widely used textbooks and items contained in tests on usage. We need tests of English usage that take into account the regional standards of acceptance described in the linguistic atlases.

A third development is that of finding ways of assigning English teachers a class and pupil load enabling them to have pupils write as much as feasible and then to find time to evaluate the compositions constructively, not merely proofread them. Many teachers have pupils keep journals in which they write several times a week to supplement the writing they do for the longer compositions. As mentioned earlier, some districts are using qualified lay readers and are scheduling classes in patterns that allow teachers time for conferences with students.

In addition to the problems of logistics in teaching composition, at least two others stand out. First, how much writing and what kinds may be beneficial? Second, how does a teacher establish valid criteria for judging the worth of a composition? You are well aware of the College Board's experiment in using the General Composition Test. You are also probably familiar with the recent research conducted by Paul Diederich, John French, and Sydel Carlton, all of the ETS Research Division. They set out two years ago to "define experimentally the diverse criteria used by readers in deciding the merits of (college) freshman compositions." The bulletin, ETS Developments, for February, 1961, contains a brief report of their findings. The title of the piece tells us what we had suspected: "Judges Disagree on Qualities That Characterize Good Writing." Yet teachers of English have to make these judgments almost every day. The problem remains. It even increases with the introduction of lay readers into this complex, subjective process. I understand that the same problem of determining standards that can be somewhat

uniformly applied by a large number of readers or by two of them caused the demise of the GCT. I fear it may be doing likewise to many of us teachers of English.

Many schools are now using the STEP tests. So far as I can tell from my work with the schools, teachers find these extremely useful in diagnosing and measuring students' ability to discern stylistic, rhetorical, and grammatical merits of multiple-choice items. But at least two problems persist: transferring this "editorial" ability to the composing of themes and then judging the results in a way that makes sense to the writer and to some other reader.

A fourth development is the teaching of critical thinking and problem solving. Many of the items in the STEP tests of writing are selected and designed to test students' ability to think critically. Some teachers use the teaching of composition as a means of instructing pupils to develop the skills of critical thinking and of using the techniques of problem solving. When they evaluate the papers, they look especially for evidence as to the kind of thinking the writer is doing. But we need tests specifically designed to diagnose the kind of thinking students do.

A fifth development, just now beginning, is the use of materials for programmed self-instruction. We need to learn what aspects of English as a classroom subject can effectively be reduced to programmed learning. At least one book has been published, English 2600 (Harcourt, Brace and Company, 1960), based upon the principles of programmed learning. Several problems inhere. How can we reduce elements of English grammar, punctuation, capitalization, and perhaps spelling and vocabulary to the detailed, itemized steps of programmed self-instruction? How do we teach those who are preparing teachers and then the teachers themselves to develop these materials appropriately? If teachers can learn to produce these materials tailored to their classes or can withdraw them from a bank of such items, they will probably be free to devote much more time than now to important matters of literature and organization of compositions, style, rhetoric, diction, syntax, critical thinking, and problem solving. Here is an enormously important new field for those of us preparing teachers, for the teachers themselves, for curriculum directors in the schools, and for those developing tests. In the report of last year's Western Regional Conference are two papers presenting helpful suggestions on these problems: William W. Turnbull's "Are Testing and Teaching Compatible?" and Harry F. Silberman's "Convergence Through Teaching Machines".

A fifth development is the designing of differentiated curricula for homogeneously grouped classes. Within these groups, teachers try to differentiate reading materials even further. Thematic units facilitate this kind of planning and teaching. These possibilities pose many problems, however. How should pupils be grouped? We need to have up-to-date information on the characteristics, needs, and potentials of pupils. English teachers particularly need to know what values adolescents consider important. How do we measure the relative effectiveness of homogeneous and heterogeneous English classes? How do we know whether we are achieving our purposes in teaching literature? How, for example, do we measure appreciation of a poem? How can we tell whether pupils are becoming lifetime readers of books? How do we know what effect, if any, we may be having upon pupils' system of values? How do we know whether students in Advanced Placement classes do any better in

college than students of equal ability enrolled in regular English classes throughout high school? We think that homogeneously grouped classes have advantages, but we don't actually know.

Inherent in all of these developments and problems and in the related testing is the apparently insoluble problem of judging the competence of teachers. What is competent teaching of English? If it is possible to identify these competences, can we then help others acquire them? How will we be able to measure, for example, the effect the College Board's Commission on English program has upon the skill of teachers who study in the summer sessions? Then, how in turn do we measure the competence of their pupils?

In summary, I wish to list the kinds of help we need in our efforts to solve some of the problems I have mentioned. I suspect that each of these items has implications for people interested in constructing, administering, and analyzing tests.

1. We need information from recent studies of adolescents, especially about the values by which they live and judge the world around them.
2. We need to know what kinds of grouping of pupils will be most effective for the teaching of English.
3. We need to have better information than we now have on the relative merits of the various ways of organizing and presenting the subject matter of English.
4. We need to know whether flexible scheduling of classes and the use of team teaching are producing the desired results.
5. We need to know whether graduates of Advanced Placement Programs actually do better academically in college than do students of equal ability who study the regular college preparatory classes.
6. We need to know something about how pupils can be helped to acquire an interest in and the habit of reading books.
7. As pointed out in The National Interest and the Teaching of English, we need to know something about "the emotional, physiological, experiential, and educational differences between good and poor writers" in high school.
8. We need to have the results of the experimental projects on the effectiveness of the use of lay readers.
9. We need to know how the teaching of structural linguistics to children may affect the development of their command of the English language.
10. We need to know what elements of structural linguistics may be most useful in secondary schools and how we can teach knowledge of the English language that will help pupils speak and write effectively.
11. We need to have tests of grammar that will test pupils' understanding of the structure of the English language and the ways in which it functions in conveying meaningful utterances.
12. Colleges need English placement tests appropriate for students who have been trained in modern English grammar and not in traditional grammar.
13. We need to know how to construct our own materials for programmed self-instruction and to know what aspects of English as a school subject lend themselves to this kind of instruction.
14. We need some ways of testing our impressions of students' appreciations of literature.

15. We need to know how to identify and measure competences of teachers of English and how to prepare them accordingly.

I daresay that this catalog is already too long, so I had better stop. Some of the attractive qualities of English as a subject are its scope, variety, and subjectivity. Teachers have much room for their imagination, creativity, tastes, and prejudices. But, as my foregoing remarks may have indicated, this very roominess within our subject also invites us into treacherous wildernesses and even up onto Clouds Nine, Ten, Eleven. I realize that the subjectivity of our materials probably accounts for the lack of satisfactory measuring instruments. But I like to hope that this same subjectivity may sufficiently intrigue experts in testing so that they too become caught up in our problems and find that their only escape is through their devising tests helping us solve some of the problems I have enumerated here.

COLONEL O'CONNOR: Thank you, Al. We now have some time for questions that may be addressed to Dr. Grommon and Dr. Feder.

MRS. ESTHER G. NOLAN (Consultant in Research and Guidance, Los Angeles County Schools, Los Angeles, California): I would like to ask Dr. Grommon if he knows whether the New York report stated on what basis these youngsters were two years below grade. Are they below grade in ability to read or in their mental capacity in the factors of intelligence that reading requires? In the latter case it would be an administrative problem in modifying the curriculum and not necessarily the fault of the English teacher.

DR. GROMMON: I fully support this view, of course, that the curriculum must be appropriate for the pupils. I thought that I had made it apparent in my other comments. Differentiating the courses and materials and expectancies, according to what we know about youngsters, is of great importance. I can't answer your question. I took this report from a recent issue of the "New York Times", which reported the Superintendent's speech presenting his budget to the Board of Estimates. This information was part of his request for more money.

There was no information about the kind of testing given in the New York City Schools. Perhaps there are others here who do know.

MRS. NOLAN: If he gets all the remedial teachers he asks for, they won't be able to solve all of the reading problems.

DR. GROMMON: Well, he hasn't solved that first one, yet.

COLONEL O'CONNOR: Another question?

MR. ROBERT H. OYLER (Director of Guidance, Claremont Unified Schools, Claremont, California): I would like to ask Dr. Grommon if he sees any conflict between the current emphasis on written utterances and the current emphasis in forming language on oral utterances. Basically, I think I am saying: is "speech" still a bad word with college professors?

DR. GROMMON: Well, maybe it appears to be after my previous remarks. No, I don't think this means that the speech activities are necessarily devaluated. But we don't know how much writing is necessary, and we assume from the results of what we now see that not enough writing is being done by many students. How much more is necessary, we don't know. I didn't go into one other aspect sufficiently. That is, the problem of the teachers finding enough time to grade, let's say, a set of papers for one-hundred-fifty students each week. Teachers are driven to hunting for commas and spelling errors and turning the papers back with a grade.

This kind of reading of papers probably does not provide constructive help for students. But I think that as a result of the Lay-reader Program in some districts and the gradual reduction of load in the number of students and classes, teachers are finding more time to help students with their writing. Some students are writing more. I think almost equally important is the problem of the teachers' finding time to look at those papers hard enough to see what kinds of thought processes are demonstrated there, and then work from this point back to help the student improve. But this doesn't mean that speech is slighted, as far as I can tell.

MRS. NOLAN: Do you see any conflict with present trends to foreign language instruction as opposed to present trends in English?

DR. GROMMON: Well, we are shifting the emphasis, as I mentioned before, to give enough attention to the papers, which I think were slighted. Whether this is going to be a conflict with foreign languages, I don't know.

MR. SAMUEL BELLMAN (Associate Professor of English, California State Polytechnic College, Pomona, California): I'd like to ask Dr. Grommon this question: Dr. Grommon, from the heavy emphasis that you place on structural and descriptive English in the new issues and problems dealing with teachers and planners, what evidence do you have to indicate that a heavy indoctrination or a fairly sizable indoctrination in structural and descriptive English on the part of new teachers and professors of English and students in high schools--even in college--will enable students to write better and to develop more effective home study read-programs?

DR. GROMMON: None, yet. The only research that I have seen so far is the one I have seen reported in Coral Gables, and this was a very modest project. But the reason for this emphasis is that we know from the centuries of investigation in the structure of English that a good deal of what we thought of as traditional grammar is invalid. It is not a description of the way a language actually functions. We are trying to make this rapid change in the interests of equipping the teachers with what we think is a valid understanding of the way in which our language functions and to convey this concept to their students.

We hope that, through experiments and through our gaining skill in presenting structural linguistics effectively, we will be teaching a grammar that may in time have some noticeable effect upon their writing.

MR. BELLMAN: The possibility that we may go off on the wrong road--is it a mere

possibility? I follow the controversy and the C. C. C. Bulletin, and I wonder if perhaps too much investigation isn't being placed on this. Now, I am especially interested in the beginning of Roberts' book, Understanding Grammar, in which he states very candidly that he never had much success in teaching under the old grammatical dispensation. I simply wonder how much success the most inspired and "instructional" linguist will have to get students to do better work.

DR. GROMMON: As I say, it is altogether too new. We don't know quite how to do it. We are trying, but we have no evidence to answer your question. The only support I can now give to the linguistic study of language is that it does give the student a valid concept of the language. Traditional grammar does not necessarily do this.

DR. ALEX D. ALOIA (Director of Guidance Center, Loyola University, Los Angeles, California): I just want to make a brief statement. First of all, Dr. Feder referred to "Project Talent" as a means of gathering data and research for our education programs, and from the preliminary findings reported in the press it indicated that less than five per cent of the American youth could write a five-minute essay without making a mistake. The girls were better than the boys, so that ought to make the women feel better.

My question is this: Since we have so much admitted difficulty in reading, English composition, and grammar usage, why do we persist in our schools to expose our children - I know why we need to - to literature, reading the "great books" when they can't read in many cases, and they can't write? Is it justified? Can we defend it by having continual practice in techniques so that when they get out of high school they might be able to write something reasonably well? Can you respond to that, Dr. Grommon?

DR. GROMMON: Well, I assume you are not arguing that we should be content with illiteracy. This is my answer.

COLONEL O'CONNOR: We will go on.

DR. ALOIA: May I comment on what he said? For example, I just sat down with a youngster the other day who is not two but five grades below his level, and he is now taking English literature in terms of reading, and he is also being exposed to a foreign language. I am assuming that in order to understand literature, we have to read a little bit. I agree with you, we are not content with illiteracy. But why do we persist in continuing to put these youngsters in "Great Books"? Bellman just made a comment similar to this. Why are those who are behind put into these courses? Why can't we stay with the techniques of teaching them these rules?

DR. GROMMON: I agree. This is the reason I emphasize the importance of grouping the students homogeneously. My comment is that I am not sure we know how to group them effectively. I have not studied Herbert Thelan's report on his research on grouping. I have heard him talk about it, and I think his findings are going to help us a great deal in learning better ways of grouping students. I favor homogeneous grouping. Once we can get students in more appropriate groups, we can then find the materials that have content of genuine interest to them and that

they can read with success.

COLONEL O'CONNOR: The next speaker is the one who brought the clipping with him that I quoted from earlier. I might draw your attention to this. The boys say less emphasis, in fact, 10 per cent of these boys say "less emphasis should be put on English." That is of no value at all.

The next speaker is also from Colorado and points East, and he has been a long-time resident of Colorado. Professor Scherer was born in Germany and came to this country as quite a young man, and he received most of his education in this country. He attended the University of Illinois for his undergraduate work and took his graduate degrees, including the Ph. D., at the University of Iowa. He was also a high school teacher in Iowa. He was Chairman of the Foreign Language Department at Stephens College in Missouri for a long while. He has been at the University of Colorado since 1946 as Professor of Modern Languages. He was Director of the Modern Language Institute of the University of Colorado during the summers of '59 and '60, and is Director of the German Department at the University.

George will speak on "The New Modern Foreign Language Teaching and the Need for Tests in All the Skills."

THE NEW MODERN FOREIGN LANGUAGE TEACHING
AND THE NEED FOR TESTS IN ALL THE SKILLS
GEORGE SCHERER

Thank you. I can't resist beginning my remarks with a story that has been going around in foreign language circles. It isn't a story that has any real relevance here, but judging from past reports of this Conference, I have come to the conclusion that some sort of story is practically a requirement. I can only hope that the one I have selected is not one that you have all heard before.

It seems that back in the isolationist twenties there was a school superintendent who was determined to get the foreign languages tossed out of the curriculum. To his surprise he found resistance among the members of his school board. So he invited the board to a dinner meeting at which he delivered an eloquent speech setting forth all of his arguments against foreign languages. He ended it up with the one that he felt was the real clincher: "Gentlemen," he said, "if English was good enough for Jesus Christ, it's good enough for me!"

Since the word "tests" appears in the title of my remarks, I must confess that I keep asking myself why I came here in the first place. I really know very little about them, so I am going to lean heavily on some criticisms I've often heard in the profession, and I'm thinking especially of the discussions on tests that I have had with Nelson Brooks of Yale. These discussions with Brooks and others have been frequent, for since Sputnik I have traveled a hundred thousand miles to meetings and conferences of language teachers all over the United States. Nevertheless, I am still especially vulnerable when it comes to the esoteric jargon of the

psychometrists, probably because my colleagues don't know this jargon either. In fact, I know even less about psychometry than I do about psychoceramics - the study of crackpots.

The Conference theme calls for a concentration on changes that have taken place in education and measurement since Sputnik. I take it that it is permissible to talk also about the changes that have not taken place but should have. Before I get into the changes in modern language methods, curricula and testing, since Sputnik, I feel strongly that a few comments must also be made about the activity in the modern language profession in the years between the end of World War II and Sputnik.

In 1946 the Modern Language Association of America, through its Executive Council, took a hard look at reality and came up with a resolution declaring its reborn interest in furthering the study of languages and literatures, including English, in our schools and colleges. This was quite a change after the many years of almost exclusive concentration on the advancement of pure research. More resolutions followed and, in 1952, William Riley Parker, then the Executive Secretary of the Modern Language Association, obtained a substantial grant from the Rockefeller Foundation for an investigation of the situation around us and for a beginning of improvements.

The Foreign Language Program of the Modern Language Association was established in 1946. It has since served to give the profession more and more hope. Through the staff in New York, aided by many able members of the profession, the program provided aggressive and corrective leadership for a language teaching profession that had been seriously handicapped by many years of American provincialism. By 1957 the changes for the better were already quite conspicuous. The road to recovery had been found. And then Sputnik shocked the profession out of much of the complacency that still remained. The important result of Sputnik's appearance for the languages was, of course, the National Defense Education Act of 1958. Although some sort of a National Defense Education Act was under discussion even before Sputnik, there can be no doubt that this first of the man-made satellites assured the Act and accelerated Congressional approval.

A number of the titles in the Act have already had a profound influence on foreign language teaching in the United States. Title III, with its aid to schools in the purchase of equipment, has made possible an almost frightening increase of language laboratories in our schools. It is something to worry about because the shiny gadgets do not always show up in places where there are teachers who know what to do with them. Imagine the look on the face of the grammar-translation teacher, B. A. Degree, 1930, 15 hours of French, whose superintendent presents her with a completely installed language laboratory on the day after Christmas vacation! While laboratories, if properly used, can be of great assistance to the language teacher, they are certainly not indispensable. They should never be planned and purchased without the aid of disinterested experts, and they should never be installed without the assurance that someone on the language staff knows how to coordinate class and laboratory work. I can see a great big boomerang in the making here. Fortunately, the N. D. E. A. summer and academic-year modern language institutes, plus many other excellent institutes and workshops, are helping our teachers to make effective use of laboratory methods.

Other provisions of the Act that have had their influence in the language field are the Title II loan program, the Title IV graduate fellowship program, and the Title VII program for research in the mass media of education. But the one title that has helped most significantly to make some of the dreams of the Modern Language Association come true is Title VI, known as the Language Development Program. Its Chief, at first William Riley Parker, and now Kenneth Mildenberger, is the custodian of a complex, fourfold operation. There is the program for graduate fellowships in the critical languages, intended to supply the nation with a reserve of able linguists in everything from Chinese to Swahili. There is the complementary program of language and area centers, which is intended to expand graduate school opportunities for study of the critical languages and the areas where they are spoken.

More directly related to my topic today, however, are the two other units of Title VI which are already revolutionizing modern language teaching in America. I'll speak first about the Research and Studies Unit and then about the Institute Unit.

During the first two years of the Act six and one-half million dollars were obligated for studies, surveys, research and the development of specialized materials designed to improve modern foreign language teaching in schools and colleges. The 1960 report of the Title VI Research and Studies Unit lists no fewer than 115 projects then under way. In the context of my assignment here, at least three of the 115 projects are of special significance: (1) The development of modern instructional materials, for grades 7 - 12, in the five most commonly taught foreign languages - French, German, Italian, Spanish and Russian; (2) The development of modern achievement tests, covering all of the four basic language skills in the same five languages; (3) The development of teacher proficiency tests, covering seven competencies, which will enable the teachers to assess themselves, in the same five languages.

The instructional materials project is well under way. Under the able leadership of Mary Thompson a team of writers in five languages has already produced Level I of these materials - Level I being the amount of a foreign language that can be learned, say, in grade 9. Level I has been thoroughly field-tested, first in the demonstration classes of the institutes of 1959 and 1960, and then during the current academic year in about 100 pilot schools throughout the nation. In March of this year Level I was turned over to a commercial publisher, Harcourt, Brace and World. We have the assurance of the company that the materials will be ready for distribution to the schools by next September. Levels II, III and IV are projected for the near future, so that a full four-year sequence is now assured for teachers who want to begin an audio-lingual program next fall.

The new materials are called Audio-lingual Materials because the listening comprehension and speaking skills only are taught at the beginning, and audio-lingualism remains as the fundamental axis throughout all levels. The program is based on what we have learned especially from descriptive linguistics, but also from philosophy, psychology, cultural anthropology and, to be sure, from a few new discoveries made by the language profession itself.

The memorization of natural dialogues is the basic principle of the new approach,

and each dialogue is followed by drills designed to internalize the new structures of the language, one at a time. The materials also enable the child to personalize the language used; that is, he can talk about himself. The teaching materials will have an entirely new format. The student manual will be of the loose-leaf notebook variety, and the lessons will be handed out only after they have been mastered audiolingually. The time-lag between such mastery and the reading of the same materials may vary from one week to six or more, depending upon the teacher, the situation, and the results of further research.

The dialogues will be available on small discs for home study. They will also be available on large L-P records and on tapes for the school's language laboratory. A series of achievement tests will be provided, and a detailed teacher's manual will spell out in plain English the necessary instructions for those not familiar with the approach. The full-blown theory behind this radical departure from conventional texts is available in Nelson Brooks' recent book: Language and Language Learning, Theory and Practice, also published by Harcourt, Brace and World.

But this pioneering venture by the U. S. Office of Education will not be the only one of its kind in the materials development field. Textbook publishers, knowing what was coming, have recently been hard at work on new language series of the type the profession has wanted for a long time. With the financial aid of the N. D. E. A., the profession finally convinced the publishers that it meant business.

A concomitant of the materials development project is the classroom progress-test project which is in the hands of the best foreign language testing expert in our profession, Nelson Brooks. Under his direction, sixty people have been working on item-writing, with the assistance of many technical experts from ETS and particularly from its Cooperative Test Division. The tests will probably be known as the MLA Cooperative Progress Tests.

Tests are somewhat like Easter hats--they range from captivating to exasperating. This is a slight revision of a turn of phrase coined by Nelson Brooks and used in another connection. He said, "captivating to nauseating", but I want to go home in a jet, sitting up, and not in a coffin, lying down. The coming Brooks tests are among the most captivating tests I know. They are already being pre-pre-tested in a few schools. They will be pre-tested on a grand scale next year, and they will be ready by 1963. They will be made for two levels: level one and a half and level three and a half, and in two forms. They will cover all of the language skills--listening, speaking, reading and writing--in five different languages. The norms will be set up on the basis of the types of schools in which the tests are pre-tested. It is hoped that this series of tests will take the place of the old Cooperative Tests, which are now severely outdated.

There is another series of captivating tests known as the Modern Language Association's Foreign Language Proficiency Tests for Teachers and Advanced Students, which are being developed with the active collaboration of ETS, and under the brilliant leadership of Wilmarth Starr of New York University. The tests cover the seven competencies that the profession has identified as being essential to good language teaching: listening comprehension, speaking, reading, writing, language

analysis, culture-civilization, and professional preparation. The tests are going to be available in five language fields and in two forms. They were thoroughly pre-tested both at the beginning and the end of the 1960 N. D. E. A. summer institutes, and in a few additional control programs. In a March, 1961 newsletter the director, Wilmarth Starr, said the following: "Among the uses contemplated are placement, diagnostic and proficiency measurement in graduate programs and very probably in undergraduate major programs at advanced levels. Several institutions have indicated an interest in certain of the tests in connection with graduate language requirements. A major use is anticipated as a result of expressed interest on the part of State Certifying Agencies in connection with or as a supplement to State Certification Requirements." Revised forms of these tests will be administered in the 1961 summer institutes, and at the end of the summer standards and norms will be set up so that the transition to general use can be made. We are confident that these tests will work well for some time to come.

This brings me to the language institutes of the Language Development Program, the fourth of the programs of which Kenneth Mildenberger is the chief custodian. In 1959 almost 1,000 modern language teachers from our elementary and secondary schools were given the opportunity to upgrade themselves in the seven teacher competencies I mentioned before. In 1960 some 2,000 additional teachers had the same opportunity. In 1961, about 4,000 more of our language teachers will attend the institutes. The implications for change in the classroom are, of course, obvious. Most of the 7,000 graduates of institutes who will be teaching next fall will be using materials of the type I described before. They will be using the new approach because they will have been trained for it, through demonstration classes, by expert high school and grade school teachers of languages. From the favorable feedback that is coming to the directors of the institutes, we know that most institute graduates actually do adopt the new approaches. Heretofore, they have been somewhat frustrated, however, because new materials beyond the first few units were not available to them. In desperation many have produced their own. The 7,000 re-trained teachers that we will have by September represent a substantial segment of the profession. We know, for example, from one of the surveys made by the Modern Language Association's Research Center, that there are about 26,000 secondary school teachers of modern foreign languages in the nation. We also know that many of the institute graduates are in influential positions as department heads, system and county supervisors, and consultants in the state departments of education. They are energetically at work re-training their many colleagues in the newer techniques. Add to all of this the fact that we have always had some teachers who never gave up the direct method in spite of the difficulties of accomplishing much with it in what was, until recently, a standard two-year terminal sequence. And, of course, some of our colleges are finally waking up, so that many new teachers are now getting the kind of training the institutes are providing for those in service. At the University of Colorado, for instance, almost all beginning language courses in ten different languages will be taught audio-lingually by next fall.

In the professional revolution that I have tried to describe there is a clear and vibrant cry for new tests that are compatible with the newer teaching approaches.

These tests must cover all the skills, for we have learned that none can be tested indirectly. If the national tests of the various prestige agencies do not become relevant to the newer teaching, great damage will be done. In fact, much damage has already been done because many of the re-trained teachers are forced--or think they are forced--to pollute their audio-lingual approach with drill in grammar-translation. The tests, in other words, are seriously blocking progress.

Let us look at some of these instruments that now determine the fate of thousands of students each year who are seeking free trips to Europe, entrance to college, advanced placement, or acceptance in graduate schools. I mention the free trips to Europe first because I have an unofficial confession to make for the profession. We have a series of national organizations known as the AAT's, that is, the American Association of Teachers of _____, and you can fill in almost any common language. Some of these AAT's are now sponsoring national contests for high school students, and the winners get attractive prizes, such as jet flights to Europe. But you should see the tests! They are excellent examples of the exasperating variety. To begin with, they are very deceptive in that they look as though they were standardized, but in actuality they are pre-tested only to a very limited degree, they are not subjected to an item analysis, and they are not normed. There is neither any uniform control over the conditions under which they are given nor over the manner of scoring. What is even worse, they foster everything except audio-lingualism, the most important training for a student who is going to profit from travel abroad. In preparing students for these examinations teachers must concentrate on grammar and translation. As one student said, "I had two years of Basic French and when I got to Paris I couldn't find anyone who spoke Basic French." It has been wisely suggested that the AAT's now sponsoring these contests, and those contemplating similar ones, call a moratorium on the written tests and substitute a variety of audio-lingual situations. These might well be interviews, debates, skits or declamations, all in the foreign language.

And what about the College Boards? They are even more exasperating because they have so much prestige. No one can really force a student to participate in a contest, but if he wants to go to a good college he may have to submit to the College Boards, and on the teacher rests the responsibility for his success. So here we go again. Time must be stolen from audio-lingualism to cram for what is in the College Boards, or what the teacher thinks is in the College Boards, for the teacher has only a vague notion as to what they are like. The last complete test was distributed in 1941. So the teacher now teaches toward the small sample that is provided and toward his own assumptions as to what the total test must be like. Although our spies tell us that the student is no longer asked to translate, the teacher is not sure of this. Knowing the tradition of the College Boards, the teacher takes no chances and drills his students in grammar-translation, that is, translation from English to the foreign language. The College Boards, of course, still weight the score heavily in favor of the literary language. While the profession is by no means forgetting about the visual and the graphic aspects of language, it feels that there must be an adequate representation of the spoken style in any such test.

The recent addition of a listening comprehension test to the College Boards was most welcome. But it was made optional. To complicate the matter it was

administered in the schools under test conditions that varied from very good to very bad. This, of course, generated much justified criticism. If it is impossible to give the entire battery in controlled test centers, then it would seem more judicious to give the written tests in the schools and the listening comprehension tests, as well as the hoped-for speaking tests, in the testing centers. Adequate control over the written examinations is possible in almost any school, but for the audio-lingual tests this is at present out of the question.

Let us take a quick look at the Advanced Placement Examinations of the College Board, which now include a listening comprehension section. On the whole, this section is quite commendable. However, in some of the examinations which I have seen there is exhibited a disturbing view of what listening comprehension really is. This is a skill which can very easily be tested purely. By this I mean that in order to test for listening ability one does not have to include reading. Whenever the stimulus is given on tape and the multiple choice answers are before the student to be read we do not have a pure listening test. The student who can't read will fail the test, even if he understands the spoken language perfectly. We do not have to give up the machine-scorable answer sheets in order to make the test pure. There is the simple expedient of taping the possible responses as well as the stimuli. If someone should say that this might then become a test of memorization rather than of French, I would suggest that the stimuli and the possible responses be played twice. But in order to increase the difficulty of the test, the items might well be played only once in the latter part of the test. The criticism that testing conditions vary exceedingly from school to school can be taken care of by the use of the testing centers.

Among the more exasperating tests are the language tests in the Teacher Education Examination Program. They have no listening or speaking sections, so that they do not tell us very much about the candidate's potential as a teacher of language as communication. These tests were normed chiefly in teachers' colleges, and this fact probably explains why they are not very discriminating. Good candidates for graduate work find themselves hitting the ceiling of these tests with their heads. Probably the main reason that good students keep wanting to take the tests is that they offer a readily obtainable high score for the record. Unless these tests are to be replaced by the Modern Language Association Foreign Language Proficiency Tests for Teachers and Advanced Students, the language tests in the Teacher Education Examination Program will have to be completely overhauled and expanded to cover all the skills. The new versions should also be devised so as to provide for part scores for diagnostic purposes.

The Graduate Record Examinations are not very enlightened either. The main trouble with these examinations in the language field is that they put too much emphasis on literature as opposed to language skills. It is a known fact that The Graduate Record Examinations do not show whether or not a student is prepared for graduate work. I should like to give two reasons for this assertion. First of all, in many graduate schools the literature courses are conducted in the foreign language. While it is important to know how good a background in literature a student has and whether or not he has ability in literary criticism, we must also know whether he controls the spoken language well enough to follow the lectures

and participate in the discussions. Furthermore, we subsidize many of our graduate students by giving them beginning language courses to teach, so it is doubly important that they be well versed in all of the language skills.

The second reason for the criticism of this test is that foreigners taking it have a great deal of difficulty with fixed-response tests simply because they are not accustomed to them. This is such a very important matter in the foreign language field because we have many non-Americans in it. In addition, the non-Americans working in the field of a language and literature which is native to them have no opportunity to show their superior audio-lingual ability.

In view of the failure of The Graduate Record Examinations to provide the information we need, we are left to our own devices for determining the ability of students to participate in graduate course work given in the foreign language and also their ability to teach beginners with an audio-lingual approach. We have the choice of interviewing them or of requiring them to submit, along with the rest of their credentials, a tape recording of some material in the foreign language in which they wish to work. The interview is, of course, the better technique, but it is usually not very practical. The tape recording is not a guarantee that the student has sufficient fluency in the language, but it does help in determining voice quality and the degree of accuracy in phonology. There may be other ways by which one could solve this problem but the simple way would be to include listening and speaking sections in the Graduate Record Examinations.

The construction of relevant tests that cover the target discipline fairly and completely depends in large measure on the appointed committees and the inner compatibility between the technical experts and the subject-matter people. There are many bright people at the test production centers. There are also quite a few in the language and literature profession. The two groups need each other badly. Some of the bright professors can write good test items and some simply can't. Some of the testing experts have more talent for working with one subject-matter group than with another. It has been suggested that the professors being considered for a committee assignment might be asked to submit a few test items before a commitment is made. This sounds like a workable idea. By the same token, I would suggest that the psychometrists being considered for the same assignment be checked somehow for their degree of ability to see the problems of the profession.

It is worth noting that professors with national reputations for their teaching and research are not necessarily the best test-item writers. This business requires a special talent. Sometimes the relatively unknown assistant professors have this talent. We ought to attempt to identify more of these people in the future.

In addition, the strenuous effort usually made to get geographic representation on every test committee is really unwarranted. It isn't very wise to sacrifice a good item writer because he lives and works in the same region as another. For all I care, if the best half-dozen people for a certain committee all happen to live in Rhode Island, let's sign them up. Think of how much cheaper it would be to get them all together!

I have heard it suggested that we need a high-level commission in each of the subject-matter fields, a commission that could advise ETS and all of the other organizations that publish and distribute tests concerning the needs in new tests, the disposition of old tests, etc. This, it seems to me, is an admirable suggestion.

Those who only a few years ago were convinced that the teaching of modern foreign languages was headed for the graveyard are now aware that this was self-deception. The jets have annihilated distance. We are involved in affairs all around the globe. International TV will soon be a reality, and so will the Peace Corps. Language for communication is indispensable in our time. This is the one chief reason for audio-lingual approaches.

No one among the audio-lingualists whom I know wants to neglect literature. On the contrary, they know that an audio-lingual ability in the language will make the subsequent visual-graphic study of literature far more meaningful than ever before, and this is the other chief reason for audio-lingual approaches.

Language in the air is now just as important as language on paper and that is why I have talked so much about the missing audio-lingual tests. We now know how to make them so there's no longer any real reason for omitting them. Unfortunately, the speaking tests cannot follow the happy pattern of pencil marks on a sheet of paper. But they are badly needed everywhere, in education, in government, in industry and in research. And if it should be suggested that the teachers will teach toward them, so much the better.

COLONEL O'CONNOR: Very fine, George. I enjoyed it, and the audience will, I am sure, appreciate having a written copy of your remarks. I would venture a guess that the teaching of languages has improved more remarkably since World War II than teaching in any other subject matter area.

I watched some measurement going on at my own institution last week. The end-of-the-year examination of all Cadets was taking place in each foreign language, and it was entirely verbal. Every Cadet came before four instructors seated around a table and talked with them in the language he had been studying. No English was used whatsoever.

Now may we have some questions for George Scherer?

MR. T. LESLIE MACMITCHELL (Director, College Entrance Examination Board, Western Regional Office, Palo Alto, California): Dr. Scherer, perhaps the first comment I ought to make is a humorous one, "It is nice to be among friends, even if they are not your own." Dr. Feder, in his paper, made reference to prominently known people, specifically Dr. Holt and Dr. Tyler who took some statistics on testing and made two entirely different deductions from them. Dr. Holt felt that schools are very much concerned about testing; Dr. Tyler felt there is no serious problem. Dr. Holt, as Dr. Scherer suggests, felt that teachers are teaching to tests. I suggest that this is a criticism of teachers, rather than of tests.

Any teacher who takes the trouble to read the descriptions of the language tests in

the descriptive booklet will have a very clear notion of what the tests are like. It is difficult to see how letting a teacher see a single complete test would help her appreciably in better preparing her students for another form of the test, and the educational soundness of teaching specifically for a test would be questioned by most teachers.

In connection with College Board Achievement Tests, which include foreign language testing of 350 College Board member colleges, about a third of them require one or more Achievement Tests. The majority of these colleges require them for placement purposes, not admission.

The University System of Oregon, for example, has just moved to a requirement of Achievement Tests for all entering students for placement purposes. At the University of Oregon, the test in foreign language is specifically required.

Several other comments are in order. First, the purpose of the Achievement Tests is to test what is being taught in the secondary schools. If the secondary schools are not teaching by the audio-lingual method, it will do us no good to test this particular skill. As soon as the fine work being done in this area by the Modern Language Association is accepted and used in the schools, the College Board Examiners will respond. We don't want teachers to teach to the tests, we want to test what is being taught.

Second, listening comprehension work and listening comprehension tests are gaining in popularity. Rarely do I visit a college or school that does not have a language laboratory, of which it is very proud. However, I know of few colleges that are requiring listening comprehension tests of entering students. I do know of many who would like to and, hence, I believe we will see a considerable growth in listening comprehension test requirements in the next several years.

Third, it was suggested that these tests should be administered at national centers, instead of in the schools. They are not offered at national centers because there is not sufficient demand for such testing, and the equipment needed in testing is extremely expensive. For the past four years a committee has been working on this problem, that is, to obtain audio equipment which would do the job effectively and yet at relatively low cost.

When it comes to providing tests of listening comprehension, the Board and ETS have struggled hard, against formidable practical difficulties, to come up with workable solutions, and no one knows this better than Nelson Brooks. The Board and ETS have been active from the start in the development of listening comprehension tests. Nelson Brooks was a member of an ad hoc committee appointed by the Board to explore ways of administering these tests at centers. After seeking out and reviewing the best advice available on all possible arrangements, the committee agreed there was no satisfactory solution that would cost less than half a million dollars. Listening comprehension tests were developed, however, and were introduced in the regular Placement Program, and in the Advanced Placement Program. Their introduction in the Supplementary Program last year represented a resourceful solution of the problem of somehow fitting them into the Board's admissions testing program. The fact that they are administered only at

schools which choose to administer them, and under varying conditions makes it imperative from the Board's point of view that they be regarded as optional.

Fourth, our Achievement Tests in foreign languages are made up by school and college teachers - made up to reflect what is being taught in the schools. It seems to me, therefore, that if teachers are exposed to the new theories of the Modern Language Association and accept and use them, it will not be long before our committees will begin to introduce these new techniques into the tests.

In summary, there are several difficulties here for the Board. It is the function of each subject-matter examining committee to prepare a test that will be as fair as possible to all candidates, coming from different schools and taught by teachers with somewhat varying objectives, using a variety of methods and materials. Many teachers are now using the audio-lingual approach, as Dr. Scherer indicates, but many are not. In fact, some are opposed to the approach. The community of school and college language teachers is by no means united on the question of the role listening and speaking skills should play in the teaching of language. The College Board examiners have prudently taken a neutral position.

COLONEL O'CONNOR: That question was well put. We expected that from Les MacMitchell, and I am sure everyone has appreciated it, and I am sure George was angling for it, too. Any other responses here?

DR. WILLIAM M. SLAICHERT (Associate Professor of Education, Denver University, Denver, Colorado): Would it be possible or desirable for the English teachers and the foreign language teachers to get together in the teaching of language? We will ask that of Dr. Scherer, the fellow from up the Turnpike way.

DR. SCHERER: They already have. In March we had a meeting at Indiana University. There were present eleven well-known Chairmen of English Departments and eleven Directors of Foreign Language Institutes, and this was the whole idea of the three-day meeting. Among those present were the men I spoke of - Nelson Brooks, William Riley Parker, Kenneth Mildemberger, men from the Institute Unit in Washington, and many other resource people; and we discussed for three days the possibility of organizing institutes for teachers of English, sponsored under the N. D. E. A.

After the first day - maybe I should say after the first evening over the bourbon - these English boys got pretty well warmed up to the whole situation. At the beginning I think they felt that the people in Modern Languages really couldn't be very helpful, but they listened attentively, asked many searching questions, and I think they went home with a great many ideas about organizing institutes for teachers of English. I hope that out of all of it will come, first, some money from Congress for N. D. E. A. English Language Institutes and, secondly, a good program.

DR. GROMMON: May I comment briefly on this question? Certainly the National Council and the other groups of English teachers are welcoming this kind of co-operation. In connection with an earlier question about language versus structural linguistics, I should report that until recently one of the strongest forces

requiring English teachers to teach traditional grammar was the teachers of foreign languages. They insisted on traditional English grammar's being taught so they wouldn't have to teach so much of it. Now the reverse is true. Many teachers of foreign language are teaching linguistic concepts of language. Whereas before they were forcing us to teach traditional grammar, now they are leading us in teaching structural linguistics.

COLONEL O'CONNOR: We have not heard from the science people yet, and we have a lot to learn. We will adjourn now until 1:45 p. m.

(The morning session was adjourned at 12:00 noon.)

AFTERNOON SESSION

The Tenth Annual Meeting of the Western Regional Conference on Testing Problems on "Changes in Education and Measurement Since Sputnik," sponsored by the Los Angeles office of the Educational Testing Service, convened at 2:05 p. m. in the Blossom Room of the Hollywood Roosevelt Hotel, Los Angeles, California, General Chairman Colonel Virgil J. O'Connor presiding.

COLONEL O'CONNOR: We have two speakers this afternoon, and we will start at the appointed time. At 3:30 you can leave. We don't know whether the speaker will stop or not, but you can leave.

The first speaker this afternoon is also a neighbor of yours from the North. Dr. John L. Kelley did his undergraduate work at UCLA. He was born in Kansas and received his Ph. D. at the University of Virginia. He served time at the Institute for Advanced Study at Princeton and was a Fulbright Professor at Cambridge. In addition, he for a time graced the math departments at both the University of Chicago and Notre Dame. He is now a Professor of Mathematics at the University of California at Berkeley. He is a member of the Committee on the Undergraduate Program of the Mathematical Association of America. Among the books to his credit is Introduction to Modern Algebra, which served as the text for the widely viewed Continental Classroom television series on modern algebra. Dr. Kelley's charm and gifted presentation of this series have made him the most widely known mathematics professor in the United States.

If I tell you the story on him, you will know it is not true, but it is about his way with students. This young fellow, like Dr. Kelley here, wanted everything to be proved, and he was always interrupting: "Well, can you prove it?" One day he wanted to see the document that Professor Kelley had referred to and Professor Kelley said, "It is in my files somewhere. I am quoting from it. I will show it to you sometime if you want to see it." The kid said, "In the meantime, until I see it, is it all right if I call you a liar?" The Professor didn't stop him. He said, "Young fellow, I assume your parents are married." The poor kid said, "Why, of course, sir." Oh, I can see you are with me this afternoon - I guess you can figure out the rest of the story.

I will let Professor John Kelley, teacher of modern mathematics, proceed.

THE TEACHING OF MODERN MATHEMATICS

JOHN L. KELLEY

We were just comparing notes at lunch. My great grandfather came from Ireland during the potato famine, and we don't think that our great grandfathers were on the same ship. They missed by a couple of years.

I am supposed to talk on "Changes of Education and Measurement Since Sputnik," and in particular on the "Teaching of Modern Mathematics." Perhaps I am here under

false pretenses, because I will have very little to say about changes since Sputnik, although some of the things I will be talking about are changes that have occurred since World War II. I will have very little to say about testing, but the things I want to talk about have something to do with testing. I think, instead, what I will try to do is say something about modern mathematics. In a highly organized society, we have such specialized jobs that it is frequently difficult to explain to someone else what you do. If you say you are an economist, a chap may ask you to help him with his income tax; if you say you are a mathematician, you are likely to be asked to add the bridge score. So, I want to talk about my job, which is mathematics, and about the change in mathematics, which has been called lately by Marshall Stone, the "Revolution in Mathematics." I am a little bit afraid of the term "revolution" since the Cuban episode, but I guess I can talk about it.

One of the things that many of our students do not realize is that mathematics is a changing, growing discipline. New mathematics is being invented every day and at a rate which is downright appalling. I will try to give you some figures to explain what I mean by this: There is a review magazine called Mathematical Reviews, which gives a short summary of new mathematics as it is printed. Normally, an article - a research article - which is perhaps ten or thirty pages will be reviewed in something between two and five inches of type. In 1940, the number of pages in a year's issue of Mathematical Review was four hundred. That isn't the number of pages of new research; that's the number of pages of reviews of new research. Many people will find this shocking.

In 1960 the same journal, by the time they published the last volume - and they are still missing one issue of 1960 - will have eighteen hundred pages devoted to review of new mathematical research. What is even more shocking, our best estimates are that in 1962 there will be four thousand pages in Mathematical Reviews. There has been a tremendous explosion of mathematical research and invention, which is one of the things I wanted to tell you about.

There are many new mathematical subjects and new applications. By request, I will tell you a story concerning a new subject, a new theorem. Many people feel that mathematics ended, at the latest, with Newton, and I have often been asked to give an example of a new mathematical theorem which has been proved in this century. So I will give you such an example.

Most mathematical theorems require quite a bit of mathematics to understand them. It is like listening to someone repairing a radio - "circuits," "tubes," "resistors" - you can't make it out. So I will tell you in very informal terms a new theorem. Consider the following situation: You have a cue ball and, by some great good fortune, you were able to grow hair on this billiard ball. You are now in possession of a hairy billiard ball. For some reason you are feeling tidy, and you want to comb the hair on this billiard ball, but that isn't all - you want to comb it straight, with no part, no cowlick, or no swirl. This, then, is the problem which you have posed for yourself. You have the furry, hairy billiard ball, and you want to comb it tidily, with no part or no cowlick. Now, it is a theorem of this century that you can't. This is a rough statement of that theorem. If I stated it mathematically, I would say there is no non-singular vector field on a sphere,

and you wouldn't like this. I believe, if you think about it a few minutes, you will see that the theorem is probably within reason. If you try to keep combing the hair all the way around the cue ball, you are going to have trouble. If you grow hair on a doughnut, the problem is much simpler, because there is not one, but several, ways of combing this. This is a very informal statement, but this is one of the new theorems which is fairly easy to describe in nontechnical terms; and there is some content to the theorem, even though I have described it in this facetious fashion. This is one bit of new mathematics.

I said, and I want to go back to this, that there are both new subjects and new applications. Let me talk a moment or two about some subjects which are quite new. Let us suppose now that we are thinking from the point of view of applications. Suppose that you are a manufacturer, and you manufacture fuses to put in the circuits of your house. You don't want to manufacture faulty fuses, because the house may burn down; so you want to test the fuses. Now, there is a very simple way to test a 15 amp fuse. You put it in an overloaded circuit, and if it burns out, it was a good fuse. You see the point is this: if you test the thing you can't sell it. There are many, many things which are of this character, where a test is self-destructive. Almost all new things are of this character, many things which are less prosaic than a fuse out of a fuse box. How do you want to test them? Obviously, you want to sample, don't you? You test a few samples, but there are some fairly serious problems. Let's say that you are making a large number of these. If you do not sample enough to be sure that nothing has gone wrong with the manufacturing process, you run the risk of turning out faulty and perhaps dangerous merchandise. On the other hand, if you sample too much, you run up the price unnecessarily, and you may run yourself out of business.

The problem then: What sort of sampling procedure are you going to need if you want to be 99 per cent sure the items you let through are all right? This is the problem of quality control, and there are several thousand people working on it in this country. It has been developed highly during and since the war. Now, the mathematical background for quality control is statistics and probability theory, and this is one of the bits of mathematics which is gradually filtering down from the university curriculum into the high school curriculum. One of the recommendations of the Commission on Mathematics of the College Entrance Examination Board was that probability and statistics should be offered in certain programs in the senior year of high school. This is new mathematics--new mathematics invented to meet a new situation.

I might give another example also having to do with statistics: There are three telephone companies in Ohio, and on a long distance call it is likely that you will use the lines of two or even all three of the companies. Now, it is perfectly clear how the revenue ought to be divided. You see where the call originated, and you give each company a proportion of the charge, depending on the proportion of its line that was used. There is only one trouble: making this computation is extremely tedious and it costs money. Last fall, before a Public Utilities Board, these companies asked to be permitted to divide the revenue on the following basis: There are an enormous number of calls. They proposed to choose a sample of these calls and split the revenue precisely on the calls taken in this sample, and then simply

divide the total revenue in the proportion that the sample indicated. It saves money; it saves money for the company and for the people who use the telephone. This is large-scale use of computing.

I might give another example of the sort of thing that causes increased use of mathematics, and there has been increased use. I remember a friend of mine once explained to me that the first World War was a chemist's war and if you think of the developments in high explosives and gas and such, perhaps there is something to be said for this. For evident reasons, the second World War could be called a physicist's war. There was more highly complicated equipment used, as many of the new advances were more physical in character. It is predicted that the third and last World War will be a mathematician's war, which is a gruesome thought.

I want to speak briefly about automation. There is nothing very complicated about automation. Fundamentally, if one machine controls a second machine, this is automation. You all know about automation. You have it in your kitchen; you do not turn the refrigerator motor on and off every time you want to use the refrigerator. This is done by another machine called a thermostat. The thing which is different is the degree of automation - and let me give an example. The calculations that are required to fire a ballistic missile are complex, but certainly not beyond the ability of people to do it. They are the kind of calculations that computers can do; and one might say, "Why worry about automation in this respect?" You know the old story about automation and engineering in China: A Chinese engineer was explaining to an American engineer that - well, Americans took things much too seriously. "We want to build a tunnel through a mountain. It is very simple. We put 5,000 men on one side of the mountain and 5,000 men on the other side, and we set them to work." "But you worry about whether they meet or not, don't you?" "If they meet we have a tunnel; if they don't meet, we have two tunnels." Now, with intercontinental ballistic missiles, you have computations of the sort that can be done by people without machines. You might say, "Why not get 9,000 people to do them instead of building these fantastic machines?" and it is very easy to explain why not. You see, when the missile is fired, the primary control is while the motor is burning, and that's only a few minutes, not very long. During that time one has to have information on what the missile is doing. You must have an estimate of what is going wrong and how to correct it. This information must be received, and the computations must be made of the necessary correction; and feedback must be sent to the missile in the initial few minutes of the firing. This is the sort of calculation, then, that has to be done in such an incredible hurry that, even though it is well within the possibilities of a gang of computers, it can't be done, because of time, by human computers. This is a rather advanced form of automation. You have to have the machine to tell the ballistic missile what to do.

The ability of these computing machines is rather fantastic, and I am sure you have heard stories; but let me tell you one or two more: During the nineteenth century an English mathematician - I think it was Shanks - decided he would compute π , the ratio of the circumference of a circle to the diameter. He spent about twenty years at it, and he computed, I believe, about seven hundred and some decimal places. It was his way of amusing himself. Now, shortly after the war, on the

first of the high speed electronic computing machines, a mathematician from the University of California was able to get a weekend of machine time - about seventy hours- and among other things, he computed pi to 2,000 decimal places. Incidentally, the chap Shanks was wrong from about the 500th place on. That was right after the war, and the difference between twenty years and a weekend is, roughly, the difference made by the equipment. Since that time much better computing machines have been made and the first 2,000 places of several constants, pi in particular, have been computed in about fourteen minutes. Probably the record is below that, but people have lost interest in this kind of thing.

Machines that run machines have had a tremendous stimulus mathematically, and I will say in a minute what this has to do with teaching and testing. We really are in a sort of push-button age, and I think many of you may have seen a little gadget on the market now. It is a little black box with the switch on the side of it. You push the switch down and the motor goes on, and the lid opens, and a hand comes out and turns the switch off, goes back in and the lid closes. This is a very nice example of the push-button age; but I heard a better one the other day: This is a push-button which is really needed. This push-button has no light that flashes, no motor that runs, no noise. In fact, nothing happens, except this: You push on the button and the button pushes back and makes you feel wanted.

There are other examples of new problems which make new mathematics necessary; but I think I will leave these and say what this has to do with the teaching of mathematics and the testing of mathematics. The mathematical curriculum has changed drastically. As was mentioned earlier, I belong to the Committee on the Undergraduate Program of the Mathematical Association of America, and this Committee has worked for rather more than ten years trying to improve the mathematical curriculum in the colleges. The difference that Sputnik has made in these endeavors and these developments is not in their character. The changes in curriculum and the invention of modern mathematics went on before Sputnik; the Committee on the Undergraduate Program was in existence and working several years before Sputnik. But now, having said this, what Sputnik has done is to make possible large-scale experimentation and curriculum study. The School Mathematics Study Group is one of the examples. There are also groups at Illinois, Chicago, and I don't know where else. These people are concerned with experimenting and improving the curriculum, and Sputnik has made it so you can get money to support these activities. I mean you can't write a new textbook or make a new program without financing it, and this is the thing which has changed since Sputnik in the teaching of mathematics.

I might digress to say - because I was asked already today - how good the Russian mathematicians are. I must say many people have asked me this, and the answer is: the Russian mathematicians are first-rate. Their mathematical work is possibly ahead of their work in physics and other directions. There is nothing to be gained by presuming that we are ahead of them mathematically. We are not. They are just as good as we are. We get no comfort from thinking of the international situation and our mathematical resources. Well, let's return to the changes in mathematics.

There have been remarkable changes in the teaching of mathematics in the past years, and I think I may illustrate these by relating some of my own experience. I recently wrote a book on modern algebra, which was intended for college freshmen or talented high school seniors. Perhaps this was effrontery on my part, because I never took such a course or, in fact, any course in modern algebra. It is remarkable that some of the material which now occurs at this level - college freshmen and accelerated classes in high school - is material which was taught in the junior year of college sixteen years ago, and in the graduate years of college twenty-five years ago. It is new mathematics for the level at which we are now teaching it. I might mention another example. I never took a course in probability and statistics. Closely connected with probability is measure theory. This was a graduate subject when I was a graduate student, and, as a matter of fact, it was not universally required in the graduate school. Now, at the University of California and many other schools, a course in measure theory is a standard junior course in mathematics - a third-year course. The situation is this: A mathematical topic seems to work itself to a lower and lower grade level. Things which were taught in the graduate school are taught in the college years. Things which were taught in the college years are now being taught in the high school years.

It may well be asked how we manage to add these subjects to the curriculum when no more time is added to mathematical instruction. It is well known that you can stuff only so much paper in one wastebasket, and it seems reasonable to expect that you can stuff only so much information into the students in a fixed period. This brings us to the question of the changes made in mathematical instruction and, in particular, to the changes made in teaching more or less classical mathematics. I want to talk about these in some detail but, before doing so, I want to mention one important reason that we in the universities are able to teach more mathematics to our students than previously. University students are better prepared than they were. I know it is popular to complain about the quality of entering freshmen. It is one of the favorite collegiate pastimes of professors. But I am positive - and I believe this is born out by tests - that entering college students are better prepared in mathematics than they were ten years ago or fifteen years ago. They are better prepared.

Let us return to the question of how the mathematics curriculum improves. One way it improves is that we find better methods to do things. Those of you who have studied calculus may have tried to look at Newton's Principia. If you did, I hope you were not as confused as I when I tried. Newton's Principia is not the way to learn calculus. Calculus can be and is presented better. There are improvements in ways to instruct. It is a curious fact that the way a thing is first done is usually an awkward way. A physicist friend gave me another example. He explained to me that Einstein was first led to the theory of relativity by experimental facts on black body radiation, and then my physicist friend went on to say that, of all the ways to discover relativity, this is the most difficult. There were hundreds of places elsewhere where it was lying nearer the surface. It is actually true that new discoveries usually are awkward discoveries, and that further examination will not only simplify but will clarify what is actually going on.

Another method of improvement of curriculum is by means of abstraction. Abstraction

could be called intellectual mass production. It amounts to the following. Suppose you have a mathematical situation which you notice is common to several situations or to several problems. It may be something about the numbers which is true for numbers, true for complex numbers, true for vectors and true for matrices. Then as a matter of sheer efficiency, it is a good idea to find out what this common thing means once and for all and not repeat it four or five times in four or five different contexts. This is the meaning of mathematical abstraction, and this is the reason why such terms as "group" and "vector space" are creeping into the high school curriculum. It is just efficiency, just mass production.

It is also true that room is gotten for this extra achievement in mathematics by recognizing that there are certain things, certain mathematical topics which are obsolescent. I can give an example from my own experience. When I studied trigonometry, I solved triangles, using logarithms and logarithms of trigonometric functions, and I computed by the hour every possible case for the lengths of the sides and the angles of the triangles. Three years later, when I had taken a B. A., I had to actually do some triangle solving in a surveying project. I remember my anguish when I found out that logarithmic computation wasn't the way you did it at all. You use a computing machine. That had been true since long before I started high school. The work which I did on solution of triangles in trigonometry was a waste of my time and the teacher's. The advent of computing machines has made this kind of calculation of considerably less interest.

There are other examples of the same sort of thing. One that came up the other day is this. You remember having to learn to take square roots by a long method, taking pairs of digits in succession? Well, that's precisely the wrong way to do it. This is a case of something more than obsolescence. There are simpler devices for the computation, and there have been for at least two hundred years.

There are other examples. In general, we must look at what we teach classically and revamp the curriculum, dropping out those things that are in use only because of tradition. This doesn't mean we change everything. We will still expect our college freshmen to be able to solve a quadratic equation, but we expect a lot more than that.

There is one last matter of change in mathematics which I want to mention. This is a change in what might be called clarification. One of the major achievements in mathematics of this century concerns the foundations of mathematics and logic. Let me describe this for you briefly, because it is not a very difficult thing, and it is very nice. Do you remember in Euclidian geometry that a line was defined to be "that which has length but not breadth"? Now, all of us, I think, who went through this were very much puzzled by this definition, and we were enormously relieved when we found we didn't have to use it. In general, I would like you to consider the following situation: Suppose you want to define every term? How would you go about doing this? You want to put mathematics on a really firm logical foundation so every term you use must be defined. Very well, let's think about the first definition: you are defining something; you say this something is-- and now what do you say it is, if you have defined no term? The point I am trying to make is that in any mathematical system there must be at least one undefined term.

Let's consider another example of this situation. Did you ever try to look up in a dictionary a word when you had no hint as to what the word meant? You looked up the word and got four or five synonyms for it. You picked the first and found the same word, together with the same list of synonyms. In fact, if you are completely unfamiliar with a word and with every synonym of the word, the dictionary does you no good. You have to know something before you can make a definition.

This is an informal argument. What I am trying to say is you must have some undefined term in mathematics and, in particular, in Euclidian geometry. Perhaps you need a whole dictionary of undefined mathematical terms. This turns out not to be true and this is part of the achievement that I spoke of. You need just one undefined term. This brings us to another change which is coming into the mathematical instruction. The one notion, "belonging to a set", turns out to be adequate for the definition of every other mathematical notion. The notion of set is natural and nowadays more and more mathematics is being stated in terms of sets. One needs the notion of set in talking about statistics, and one uses the notion of set in plane geometry. A line is a set of points. I think this statement would offend no student of geometry, even at the very beginning of a course.

Because of the advances in set theory and foundations of mathematics, we are now able to state more precisely mathematical things which have been stated awkwardly before. This means our curriculum must make our students aware of this more careful statement and our testing must exhibit this new clarity.

Finally, I must mention some of the experimental curricula that are being studied. The School Mathematics Study Group is attempting to offer sample textbooks, and they have completed sample textbooks for grades seven through twelve. The Illinois group has completed textbooks for the ninth and tenth grades, and I think they have started the eleventh grade. There are many other groups.

These changes will have an effect on testing which is probably the effect every change has. There is something, sometimes called the Third Law of Theory in Human Relationships, which is summarized: Things are going to get more mixed up and more difficult.

This is true of testing. Since we are experimenting with curricula, not every high school will offer the same mathematics curriculum. Many students with somewhat different training will want to enter colleges, and they must be compared on their own merits to see who is allowed to enter. This makes a problem in testing, and I am glad I don't have the responsibility for solving this problem. And this, I am afraid, is my sole contribution to this conference on testing.

COLONEL O'CONNOR: Thank you, Professor Kelley. Let's have one or two questions for Dr. Kelley.

MR. SAMUEL BELLMAN (Assistant Professor of English, California State Polytechnic College, Pomona, California): Professor Kelley, with all due respect to your excellent talk, why is mathematics so impenetrable to the nonmathematical mind? For example, even the popular paper back, Mathematics Without Tears

and Neurosis, seems almost unreadable. Why are there too few people like you around, and what is the real reason?

PROFESSOR KELLEY: This has worried me and every mathematician, I think, and I can only guess at an answer. The two disciplines in which most people have the most training are English and mathematics. These are the only subjects which are uniformly studied for at least ten years. The amount of mathematical background which is required of a mathematician is itself based on ten years of arithmetic and mathematical studies. It does seem to be the case that after ten years of study followed by two more high school years, followed by seven years of university work, the mathematical language is so complicated that it is awfully difficult to communicate to the nonmathematician. Part of the trouble is that the ability to communicate well is not necessarily concomitant with the ability to be a mathematician. It takes a special ability to explain something clearly.

I don't think that the problem is entirely in mathematics. I think modern physics is just about as difficult to try to explain to a person who has no training.

COLONEL O'CONNOR: One other question?

MR. JUDSON SANDERSON (Professor of Mathematics, University of Redlands, Redlands, California): I am happy to be a Professor of Mathematics and I agree totally with what Professor Kelley has had to say. However, I would like to ask a question concerning testing: I try to give some modern mathematics on the graduate level, and try to give as many modern courses as possible; but then, with tongue in cheek, I give what they call the Graduate Record Examination created by the Educational Testing Service; and there are 75 questions on this examination and only 5 have the remotest connection to modern mathematics. When an administrator looks at the scores of this test, he thinks we don't do so well, and he thinks perhaps the mathematics department is rather weak. My question is: When are the tests going to catch up with this trend of modern mathematics? It seemed this test was created a long time ago. In fact, I know some of the other creators, and I wonder how they got their name on this test. My question is: When is the Educational Testing Service going to create an examination relative to modern mathematics?

PROFESSOR KELLEY: Since I am not an employee of the Educational Testing Service, perhaps I can defend them. I see their difficulty. Modern mathematics, in the sense that we are using this term, is still untaught in many, many colleges. I think that what you say is absolutely correct, and we both know, having read fellowship applications, that one has to take test scores with certain reservations; but I think that your criticism is primarily at the colleges. I suspect that the Educational Testing Service will be glad to make suitable examinations as soon as we have a little bit more of a modern curriculum in a larger percentage of the colleges.

COLONEL O'CONNOR: Another question?

MR. CURT STAFFORD (Test Officer, San Jose State College, San Jose, California): I think, in partial reply to this, we will get the tests from ETS. Our students are

probably asking us when are our tests going to resemble the courses we are teaching. My question starts off with the reverse to that story, and the fastest way to lose the war is to capture the opposing generals: so if we start with the premise we want to lose our own generals, in order to lose the war, generals--not colonels--I left mathematics as such just about the time this stuff came in. Now, what things in my training should I forget, lose track of, in order to more readily grasp the newer concepts? What old ones should we kick out first?

PROFESSOR KELLEY: There is very little, I suspect, in your training that we want to get rid of. A man who has been trained in this modern mathematics, we hope, knows all the important things that a man who was trained in an earlier program knew and, we trust, knows something else besides.

COLONEL O'CONNOR: We will carry on.

Fred Ferris was born in New York City. He has taught at Lawrenceville Prep School and at Princeton University. He earned his Ph. D. at Princeton. He was long a Princeton student, for some time a Princeton teacher, and he still lives and works close to those ivied halls. Fred was assigned to the Physical Science Study Committee in '57. He was given a leave of absence by ETS for the early pioneering work with the Physical Science Study Committee. Presently, he is Director of Curriculum Studies at ETS. Fred Ferris.

SOME NEW SCIENCE CURRICULA AND THEIR MEASUREMENT

FREDERICK L. FERRIS, Jr.

Well, speaking at the tail end of a long day like this is not the most enviable spot to be in. I am fully aware of the problems on the local freeways. If any of you do have to leave, my feelings will not be the least bit hurt.

However, the last time I was asked to give a talk out here in California, the conditions were much worse. The place was the University of California at Berkeley in connection with the new chemistry course of the Chemical Education Material Study, which is centered at Berkeley. Attendance was required for all teachers and their administrators for a new course that was being tried out in the San Francisco area. The day was November 8, 1960, at 8:00 P. M. California time. This was election night. Things went off rather better than I had anticipated, however. Chancellor Seaborg of the University of California ran the meeting. He had a television set brought in and at one minute before 8:00 P. M., he declared Kennedy the winner, shut off the television, and then I was able to give my talk. Incidentally, Chancellor Seaborg is now Chairman of the United States Atomic Energy Commission.

The past four years have witnessed the beginnings of what appears almost certain to become a veritable revolution in American education -- one leading to a genuine upgrading of curriculum at all levels and in all areas.

Looking over the first half of the Twentieth Century it is almost deplorable to note that curriculum development, particularly at the elementary and secondary school levels, but even to a considerable extent at the college level, has been largely a matter of voluminous compendia and lofty statements of so-called objectives, lists of syllabi, and the writing of textbooks in an almost whimsical or capricious manner. Often such books are fraught with error and have been written by individual authors who are downright incompetent in their particular field of inquiry.

Happily, since 1956, large curriculum ventures on a scale unprecedented in American history, have been evolving in rapid-fire sequence. These endeavors have seen some of the nation's leading scholars and scientists at the college level at long last concerning themselves about secondary education. The joint efforts of these top professionals working in close cooperation with high school teachers have already produced vastly superior products at the high school level. The effects of some of these improvements are already having their impact on instruction at the college level.

I am referring specifically now to five major projects, all supported by the National Science Foundation, and indeed there has been a real shot in the arm given to these projects by support since the launching of Sputnik; but it is important to remember that this revolution -- as I am calling it -- did start prior to Sputnik.

Well, first of all, the first Science Study Committee, which was developed at MIT, really is sort of the prototype of this kind of adventure about which I am speaking. It is under the direction of Professor Gerald Zacharias, Professor of Physical Science at MIT.

The School Mathematics Study Group, which Dr. Kelley mentioned, is presently located at Yale University, but it seems to be moving to California, under the direction of Professor E. G. Begle.

The Chemistry Bond Approach Project, located at Earlham College, is directed by Professor Lawrence E. Strong.

The C-H-E-M Study that I mentioned, centered at the University of California at Berkeley, was under the chairmanship of Nobel-Prize winning Glenn T. Seaborg, now Chairman of the A. E. C.

Finally, the Biological Sciences Curriculum Study, centered at the University of Colorado in Boulder, was under the chairmanship of Bentley Glass, of John Hopkins University.

Now, there is little question that the scale of such ventures will steadily increase in the years to come. You might ask me what is the reason for such optimism. Well, there are several reasons. First of all, the almost fantastic growth, acceptance, and use of materials that are already being prepared. Secondly, there is incontrovertible evidence that we have vastly underrated the capacity of United States high school students and presumably, therefore, those at other levels, as well.

Third, there are many similar projects already in the formative stages in other levels.

Finally -- this is an important one, too -- the personal concern and vital interest of President Kennedy, himself, in these ventures is quite a factor.

Now, it should be emphasized that this revolution is taking place in the American way. The control of the course content that is being developed in these ventures is solidly in the hands of the scholars and professionals.

The use of the newly developed course materials is controlled strictly by the local school systems. Los Angeles, for example, is using almost all of these that I mentioned.

Finally, it is important to note that only the financial support is provided by the Federal Government. I said "only." This is extremely important, but this is the sole role of the Federal Government here. In other words, this is a clear-cut example of the Federal Aid to education without control.

I don't intend this talk in any sense to be a "California for Kennedy Movement in 1964". Actually, these projects started during President Eisenhower's administration -- just about in the middle of it.

Well, how did all this come about, this new approach to curriculum development? Back in 1956 there was general dissatisfaction with the deplorable state of high school physics instruction, not only on the part of college professors of physics who were deploring the entering freshmen and so on -- but there was woeful lack of background. When I talked to Professor Strong at Cal Tech, Chairman of the College Board Physics Committee, he said, "You can assume the freshmen knew no physics at all a few years ago and the high school teachers, themselves, were bothered by the fact that the high school physics courses were simply out-of-date."

In other words, the Nineteenth Century physics was masked by vast amounts of technology -- not that there is anything wrong with technology, but it isn't physics, as such. That's why the physicist messed Dr. Kelley's radio up. That is a technological application of physics. Too often textbook materials have been revised by merely changing the picture on the cover from a DC-6 to a 707. Such "modernization" is of questionable value.

The real credit for pioneering the formation of these study groups goes to Gerald Zacharias of MIT, who really had the vision to see that an all-out effort or massive attack on the problem was needed. Zacharias quickly got the financial backing of the National Science Foundation and further support, incidentally, from the Ford Foundation and Sloan Foundation; and this led to the formation of what became the Physical Science Study Committee. They met with some of the nation's top physicists, high school teachers, and other educational specialists in June of 1957 and decided to explore what needed to be done. It wasn't long before everybody was in complete agreement about what needed to be done. This, in essence, was to start completely from scratch, and those of us who were involved in this

project from the beginning had no idea of what we were in for.

The summer of 1957 saw the first steps toward the development of a brand new textbook, completely disregarding everything that had been taught in the past, and starting from scratch. Laboratory materials were designed to go along with this text. Appropriate teachers' guides, films, tests, etc. were designed to accompany the text. It is interesting to note in this connection, incidentally, that Zacharias also had the foresight to see -- as far as testing is concerned -- that tests needed to be an integral part of the development of the course and not an after thought. Consequently, the development of tests designed to reflect the course objectives had been commenced at the same time the projects, themselves, were started. This contributed markedly to the dramatic success of the Physical Science Study Committee effort.

One thing that struck me very recently was the fact that had this textbook been written five years ago by an individual author -- I don't think it could have been -- no publisher would have touched it, and no teacher at the high school level would have dared try to use it; and yet, today we find it used all over the country. This, incidentally, is the first year it appeared in hard-back form. In 1957-58, it was used by eight schools involving 300 students. In 1958-59 this number jumped to 286 schools, 13,000 students. Last year, 1959-60 some 700 schools with about 25,000 students used it, and in the current year, 1960-61, about 1200 schools with nearly 50,000 students used it. After a few years we estimate that a quarter of a million high school physics students will use it. Presently, something in the order of 15 per cent of the physics taught in this country utilize the PSSC materials and text. Soon it may run as high as 75 per cent.

The stimulus of the Physical Science Study Committee had its carry-over into other fields, and projects have been launched in chemistry, biology, and mathematics. However, I am going to use the Physical Science Study Committee as the illustration, a sort of prototype, both with respect to curriculum changes and the techniques of evaluation that we use with it. The C-H-E-M Study Group, the Biological Sciences Curriculum Study Group, etc. are using the same approach, but more is known about the Physical Science Study Committee because it has been in existence longer.

You might ask me at this point just how is this new course so much better than the so-called conventional high school physics courses of the past? In the first place, the authors of this book had in mind, not physics majors in college or even college-bound students, themselves, necessarily. This course was designed just as much for the terminating high school students as it was for the potential college physics major.

The emphasis is away from rote memory and dishing out material in an assertive way. We don't tell students that all matter is made up of molecules -- memorize that -- molecules are made up of atoms -- memorize that -- rather, the student is led to start with what he knows and discover things for himself.

The student actually goes in with minimal equipment and measures the widths of the molecule, and it is startling to see how physicists have learned what they have

learned. Science is not some nice serious man in a white jacket who authoritatively tells the student some of the mysteries of the universe.

Also, there is an effort made to get away from memorized formulae and plugging in numbers and problems that are automatically worked out. This was the kind of physics we took in school with ten problems at the end of the chapter. That kind of thing is all *passé*. "What is it then?" you say to me. Well, the book is divided into four parts which include the tests and everything else.

The first part of it was originally entitled "The Universe and Other Things". The Committee finally decided to be less pretentious and just call it "The Universe". "The Universe" was written by Professor Morrison, who is a gifted spellbinder, indeed, and the book reads that way. In fact, once you get into the thing, you finally find out what physics is all about and what physics does. It concerns the measure of time, space, matter, compensation of time and space, leading to the notions of motion and so on. It gets into a little more chemistry, accounting for matter, and it raises a lot of questions for students.

The second part of the book sets forth the spirit of the course. Secondly, I would mention that the physicists are most anxious to get across to and communicate with the students. There is a sort of a stop at the end of this particular view of physics. Now, let's take a look at something which is very obvious and see if we can study it. One of the most obvious things is light. You pose the question to the student, "What is light?" and at first this seems like a ridiculous question. Anybody knows what light is. However, when you stop to think of it, you really don't know very much about it.

Finally, the student says, "At least we can see some of the ways in which light behaves. Light casts shadows." That is a very simple thing. Then they get into the fact that light can be reflected from the surfaces, and this gives relationship between the angle of incidence and the angle of reflection. You may remember some of this. Then you note reflection, dispersion, and all the various phenomena-- all the things you can observe about the way light behaves -- and once you have noted all these various observations, there is sort of a pause about the middle of this part of the textbook; this is a very crucial part, too. It is pointed out to the students that physicists, being human like all the rest of us, given a whole set of observations, like to put them together to formulate some kind of a model or theory that will explain what is going on here in light; and this is the way scientific investigation works.

Once such a model has been developed, then it should predict other things. You check and see if it works. If it works, it is a good model; if it doesn't, it is not a good model. What is the best way of explaining how something gets from that light bulb to you here? You observe all these things about light, these various ways in which light behaves. What can be a reasonable way, a sensible way of explaining this? Well, one of the most obvious ways is to assume the particles are coming from here to here. So let's follow this a little bit. Let's assume light is just streams of particles that come out from a source. Let's check it now against all of these various observations. What about shadows? Are these particles

shadows? Well, yes, streams of particles did come out and hit this and go around, and you would get a shadow. This looks pretty good for the model or the theory.

What about reflection? If you look at balls, billiard balls, or any other kind of a hard surface, you notice that the angle of incidence does reach the angle of reaction, so this model begins to look better and better. Then with reflection, where light rays bend and so on, you can take a ball and start it rolling down an incline and study the incline. As it becomes steeper, the ball bends, and, if you notice, the relationship of reflection is wholly consistent, and so this particle model of light looks very good; and yet, we find that all of a sudden it breaks down indeed, because the model predicts that the ball, when it started to run down hill, goes faster when actually light, after it is bent and reflecting, slows down; so something is wrong with the model.

What does a physicist do when this happens? Either you change the model or you start all over again with a new model. Well, let's try the latter. Forget about these particles for a minute. How else can something get from there to here? There is one other kind of way: take waves on water, for example. The wave itself moves, but the water isn't moving in the same direction as the wave. A piece of cork will just pop up and down on the water as the waves pass underneath it.

Well, the student works in the laboratory with a little gadget known as a Ripple Tank. The little vibrators go up and down, and he notices, by an intensive study in the laboratory of these water waves going back and forth, the behavior of light in the laboratory and he studies waves and finds that, sure enough, the waves reflect in just the same way light does.

Of course, shadows are caused by waves in the same way as reflection, interference, dispersion, and all sorts of other phenomena that are not accounted for by the particle of light. Concerning this point, this little story stops, and the student is left with the feeling that the wave theory seems to account for the behavior of light much more satisfactorily than does the particle theory.

The course then goes on to develop force, momentum, the conservation laws, electricity, and finally it leads up to modern motion, midway between the motion of atomic physics and some quantum mechanics. It is really up-to-date.

I won't take any more time on that. I did want to give you a little picture of the second part of the course because it does give you an idea of what the physicists are trying to do here, and it also gives you the approach that is being used in these chemistry and biology courses that I mentioned.

Now, how do you go about testing for this sort of thing? This is not easy at all. It is easy to build the traditional multiple choice tests that you see in chemistry and physics. "What is the density of aluminum?" with five choices. This sort of thing is not appropriate at all to PSSC, and we had to steer away from that.

The approach we have used is to put the student invariably in the context of a new situation he has never encountered before. A broad problem is given to him and

it is demanded that he apply what he has learned from the textbook. Now, he could actually use the textbook. There is no objection to bringing the textbook to the class and, as he is not going to find any answers to anything in the book, the new series of tests are going to be that way. In the test for chemistry, the students must bring their books to the laboratories for the test.

Now, for the test in the laboratory. The student is presented with a slide that reads, "The diagram below consists of a portion of a wave pattern generated in the Ripple Tank. The pattern is that caused by the vibration of a generator, which is not only vibrating, but is also moving with constant speed in the direction indicated."

This is pulling a dirty trick on the student. He has this information: "The speed of the generator is half as great as the speed of propagation of the waves." This all makes sense to the student. "The speed of the waves relative to the tank is independent of the motion of the point source generator."

This should point out to the student that actually this is a Doppler effect, but it is not discussed anywhere in this textbook at all, so we are trying to see if he can elicit the Doppler effect from this particular situation. We ask him first of all some rather obvious questions and we ask him some rather obvious simple questions with relation to the wave lengths, and then something about frequency, just to get him thinking on the right terms, and then we pose a new one on him. To this time no statements have been made in the course about sound or acoustics. There just isn't room for it. It isn't that there is anything wrong with it-- this just makes an ideal test situation. We can tell the student that sound can be described as a wave motion. He is thoroughly familiar with wave motions by now, and we also tell him there is a relationship between the pitch and sound and its frequency.

This all again makes sense to him. Now, you ask him to make a prediction. This is the kind of thinking that the Committee is trying to elicit. "Predict what would happen if a body in motion was coming at you rapidly." Based on these observations here and knowing the relationship between pitch and frequency, the student may be able to deduce the idea that the pitch is going to drop because the wave lengths will increase and the frequency will decrease.

Then we switch to light. Now, here's something that has been studied-- light and relationship of velocity, frequency, and wave lengths and so on. We pose the problem of a distant star that is moving toward the earth, say, at a certain speed. What would you predict about this star? What we are trying to get at here is that the star would appear somewhat blurred in color more than it otherwise would. The students would have no other basis other than his knowledge of wave motion in the course plus this laboratory situation upon which to proceed. These approaches work. This last one was used for a special College Board Test. It had to be a special test. A regular College Board Test wouldn't work at all on these students, but when this particular problem was presented to the PSSC students in the special College Board Test, it worked very well.

As I said earlier, some years ago this kind of teaching was impossible at the high school level. Today it is being done and the students love it.

Now, what about the role of testing from the Physical Science Committee project? First, there is a series of ten achievement tests that are spaced throughout the academic year and go along with all the other course materials. These are all being standardized -- actually they are most unique. There is nothing to compare the data to, because no one has ever standardized a sequence of tests like these before. One of the purposes of building these tests was that they serve as a frank empirical statement of course objectives designed to influence the way the course is taught.

The physicists and the high school teachers who worked up the materials were afraid that teachers, once the course got out, would approach this course from a rote memory point of view. Therefore, they wanted to see to it that teachers had instruments of the sort I showed you here, which measure the kinds of deduction, productive thinking, etc., that were expected of students taking this course. Many times the question is raised, "Should tests influence curriculum?" Here is a case where we deliberately set out to do it.

A second purpose of testing in the context of the Physical Science Study Committee project was that of feedback and evaluation. Here you can't use a conventional design you might be familiar with from courses and testing measurements and so on. Namely, let's get an experimental group and a control group, and they have some criteria measurements here, from analyses of other tests. That won't work here at all because there is no criterion measurement. There are criteria measurements designed by the Physical Science Study Committee, but they won't work on your control group at all and vice versa.

Well, how do you go about it? In the first place, the question is not one of whether this physics is good or bad. Physics is good, I submit. Who is to say what is good physics if it isn't the nation's leading physicists, and we have had them working on this project in abundance. Whether it is good or not is not the question. The question is: Is this material teachable at the level and for the group for which it was designed?

Most high school physics students lie above the 75 percentile in respect to scholastic ability, and the approach we used in the studies designed for the PSSC. Other curriculum studies, by the way, are giving a scholastic aptitude test to all students, and this has been done for several years in a row now. We have acquired much data, and this battery of ten achievement tests has been helpful.

Let's say this is an advanced placement course, with the upper 5 per cent -- the very brightest of students -- and this is one of the things we wanted to see. Is this so or not? What about the validity of the tests? Well, here we have a very peculiar kind of validity, I think. It is sort of a content validity. I think it is more than that. It is possibly a validity by definition. All of these test terms were gone over by all of the physicists on the project, and we never used one of these tests until everyone on the project was happy with them.

In other words, by definition, these tests are representative of the kinds of things the Committee -- the textbook authors -- had in mind. If the students can handle

this kind of material, we will be very happy -- delighted, in fact.

As far as validity coefficients go, we could get beautiful coefficients with grades, because all the teachers from almost all the schools use test scores as part of their grades. It is so obvious that we haven't even bothered to try it.

As far as the tests are concerned, they turned out to be of middle difficulty. This surprised us. On the first one all the physicists at MIT thought the tests were going to be much too difficult. All of us were astonished as to how well the students did on these tests. One of the most encouraging things the first year of the project was that nobody believed this would happen, considering the level of apparent difficulty. That's why I said earlier that we have simply underestimated what the students can do when they are motivated and interested.

These are forty-five minute tests, and their reliability runs around .75; a composite reliability of all the tests treated as a single test was .95 plus. Now, one of the amazing facts that has resulted and one of the things I want to show you before concluding -- if I can take a few minutes -- is the inordinately low correlation of achievement with scholastic aptitude. This is an astonishing fact.

I have been working with Lee Cronback from Illinois and Jerome Bruner from Harvard on some of these studies. We still are puzzled by this. There is another very peculiar thing that happens. (Consult Table 2)* If you take these tests in sequence, the first PSSC Tests correlate around .50 with SCAT, by midyear .40, and by the end of the year the correlation has slipped down to around .20. There is a significant percentage of students who are dubbed "low aptitude" by aptitude tests. I want to emphasize that point. The aptitude tests say they are low aptitude or their grades and other subjects even may say they are of low aptitude, but actually these are students who are bored and refuse and rebel at the idea of rote memory. They refuse to sit down and memorize all the definitions, to cram the night before the exam, to burn the midnight oil. All these indications are indicative of American education in terms of interest. Where one student might say, "Once I get excited by such things as measuring the thicknesses of the molecule. . .", they find there is really something here, and you will find that the correlation is increasingly depressed by the fact that these "low aptitude" students are penetrating the higher ranges of achievement, and the opposite works, too.

Many bright students, who bank on this ability to cram, just won't work in this course at all, and they won't do well. I have a series of slides I want to run through in rapid-fire sequence, and I want you to see the change from "low aptitude" and what happens as the first year progresses.

The first slide (Table 1) shows the aptitude of the selected group of students. These norms are drawn from the 1958 - 59 and the 1959 - 60 academic years. You will note that we are dealing with essentially the upper 75 per cent of the United States twelfth grade students. I had better explain the slide because all of the remaining slides will be similar to this one.

* All slides shown in Dr. Ferris' talk are reproduced in table form following page 56.

The fat, shaded part of the graph represents 50 per cent of the population. The upper limit of the shaded bar represents the 75th percentile while the lower end of this shaded bar represents the 25th percentile. In each case the graph represents only 90 per cent of the group in question; consequently, the lower end of the vertical line represents the 5th percentile while the upper end of the vertical line represents the 95th percentile. Median SCAT scores are represented by the short horizontal line across the shaded bar of each graph. The dotted horizontal line at a SCAT score of 302 represents a score of 500 on the CEEB - SAT.

By comparing the graph for PSSC students' SCAT scores with that of the United States twelfth grade students, you can readily see that we are dealing with an extraordinarily able group of individuals. You will note that the lower quartile for the PSSC students falls at approximately the 80th percentile when compared to the United States twelfth grade students. While the selected PSSC students have a fair number of individuals who dip into the lower aptitude range, essentially we are dealing with the upper 20 per cent of United States twelfth grade students.

The next sequence of slides (Tables 3 - 11) will show the relationship of PSSC Achievement Test scores by aptitude groups for the various tests during the course. The PSSC students are broken up into three aptitude groups -- above the 90th percentile, 90th to 75th percentile, and 75th to 60th percentile -- because we are interested in seeing whether or not the course is appropriate only for the brightest students.

On the extreme left of each table, scores from 40 to 220 represent the standard scores on the Achievement Tests of the PSSC. The solid horizontal line at 130 represents the mean, and the dotted lines at 90 and 170 represent the standard deviation of plus and minus 40. Having placed the Achievement scores on such a scale, we are able to compare the sequence of aptitude with achievement, since differences and difficulty are eliminated through the use of standard scores.

As we examine these tables, it will be well to keep in mind that the 90th to 75th percentile represent the lower limit of the group for which the course was designed. The third column, that is, the aptitude range of 75th to 60th percentile, represents those students whose scholastic aptitude, as measured by scholastic aptitude tests, are below the level for which the course was designed.

Now, (refer to Table 3) the very first test on the first half of Volume I demonstrates one important thing. Here is a rather marked overlap among these groups with a fair percentage of students in the middle aptitude range doing better than the median of the brightest students, and likewise some of the students in the lower aptitude level are performing at about the median of the brightest students.

We are going to proceed through the remaining slides in rapid sequence. (Follow Tables in back) I want you to see what happens to this group (that is, the 75th to 60th percentile SCAT group) with respect to the total group as it progresses through the PSSC course and the students get into more and more complicated physics. (Shown in Table 6)

In the second half of Volume II the students are becoming exposed to very complicated modern quantum mechanics. The first half of Volume II was describing objects, if you will remember, and this, the second part, deals with more complicated physics. Notice the overlap of the 75th to 60th percentile group with the total group. As we proceed from the first three tables to Table 6 (which is the second half of Volume II) we note that the overlap is getting greater and greater. The next slide (Table 7) is a midyear comprehensive examination on the full first half-year's work.

The next slide (Table 8) is the first test covering Volume III. Here, the students are getting into dynamics, force, and momentum laws. The next slide (Table 9) is the last half of Volume III. This slide is an extraordinary one. Look at the performance of the number of students above the median of the very brightest students. Correlation at this point between SCAT and PSSC Achievement, as I recall, is about .28 (consult Table 2). The last slide shows a composite test on the second semester's work (Table 11).

The number of cases here wasn't terribly large, and we began to wonder about the significance of this. I'd like to conclude with a couple of bothersome questions here. When students perform at the 90th percentile on these tests of modern physics they are certainly not dumb, and they obviously are not low aptitude students. Anybody who can handle these -- you just take a look at these tests -- anybody who performs at 90th percentile there has something on the ball.

Now, if our hypothesis concerning the interpretation of these data is correct, I'd like to raise the question, "Does this pose a question about the nature of existing scholastic aptitude tests and those high correlates with them, namely 'grades' in school and college?"

Scholastic aptitude tests predict college grades well, so we select on the basis of the tests and grades in the same old way. If our hypothesis is correct, somehow or other we have to break out of this pattern and really do what we say we are going to do in teaching and grading students. If we do not, we pay mere lip service to lofty objectives and reward students on their ability to cram what is in the book and spew it out on the day of the final examination. I personally believe that the experience of the Physical Science Study Committee and the experience of the other curricular projects have shed some light on these matters and should help us to go a long way in producing tests that are both more dynamic and appropriate for modern education.

COLONEL O'CONNOR: That was very fine, Fred. We won't take time for questions, but there may be individuals who want to come up and ask questions at the table.

I do want to thank those two gentlemen. They gave two magnificent talks this afternoon, and the enthusiasm of Fred Ferris is typical of the enthusiasm of the whole Physical Science Study Committee since its inception.

Finally, I want to express your appreciation and my appreciation to John Helmick for having us here. I thank you for coming here and being so patient with us.

(The meeting was adjourned at 3:35 P. M.)

Table 1

Explanatory Notes:

1. Percentiles indicated are based on national norms group.
2. In each case, graphs represent 90% of the group in question; 50% of each group represented by broad segment of each graph.
3. Median scores represented by short horizontal line across each graph.

Table 1

SCHOLASTIC APTITUDE RANGES BASED ON THE
SCHOOL AND COLLEGE ABILITY TEST (SCAT)

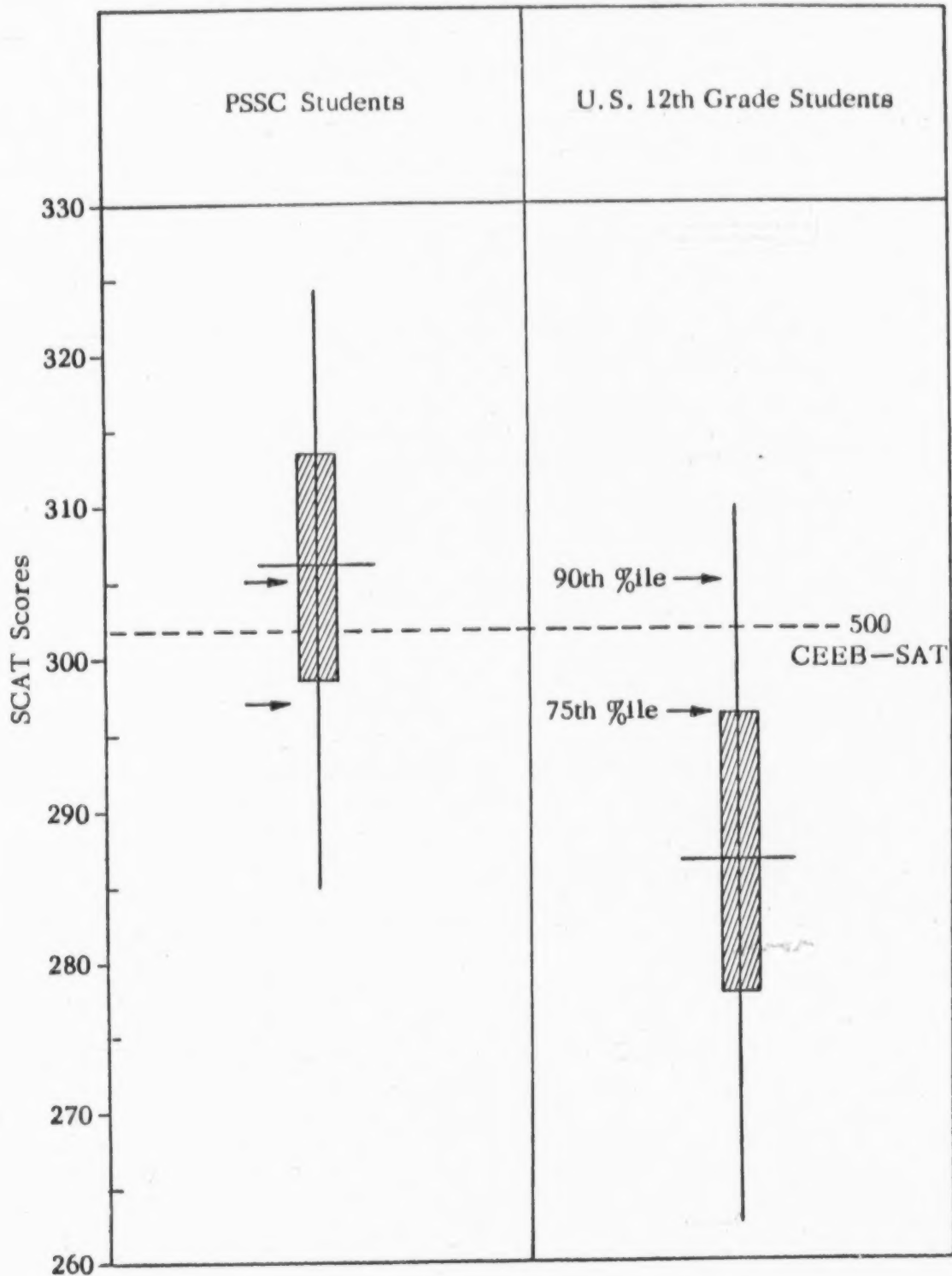


Table 2

Table of Correlations with SCAT

	<u>r</u>
Test on Volume I (Chapters 1-6)	.51
Test on Volume I (Chapters 7-10)	.54
Test on Volume II (Chapters 1-5)	.41
Test on Volume II (Chapters 6-9)	.45
Test on Volumes I and II	.40
Test on Volume III (Chapters 1-4)	.44
Test on Volume III (Chapters 5-7)	.37
Test on Volume IV (Chapters 1-5)	.24

Table of Correlations with SAT Verbal

CEEB-PSSC Physics	.45
CEEB Regular Physics	.61

Tables 3 - 11

Explanatory Notes:

1. Percentile ranges indicated are based on the national norms group.
2. In every case, the graphs represented 90% of the PSSC students falling in each category; 50% of the students are represented by the broad segment of the graph.
3. Median scores represented by short horizontal line across each graph.
4. The scale used for performance on the achievement tests is an arbitrary standard scale, with a mean of 130 and a standard deviation of 40 in every case.

Table 3

PSSC ACHIEVEMENT TEST SCORES BY APTITUDE GROUPS

Test on Volume I (Chapters 1 - 6)

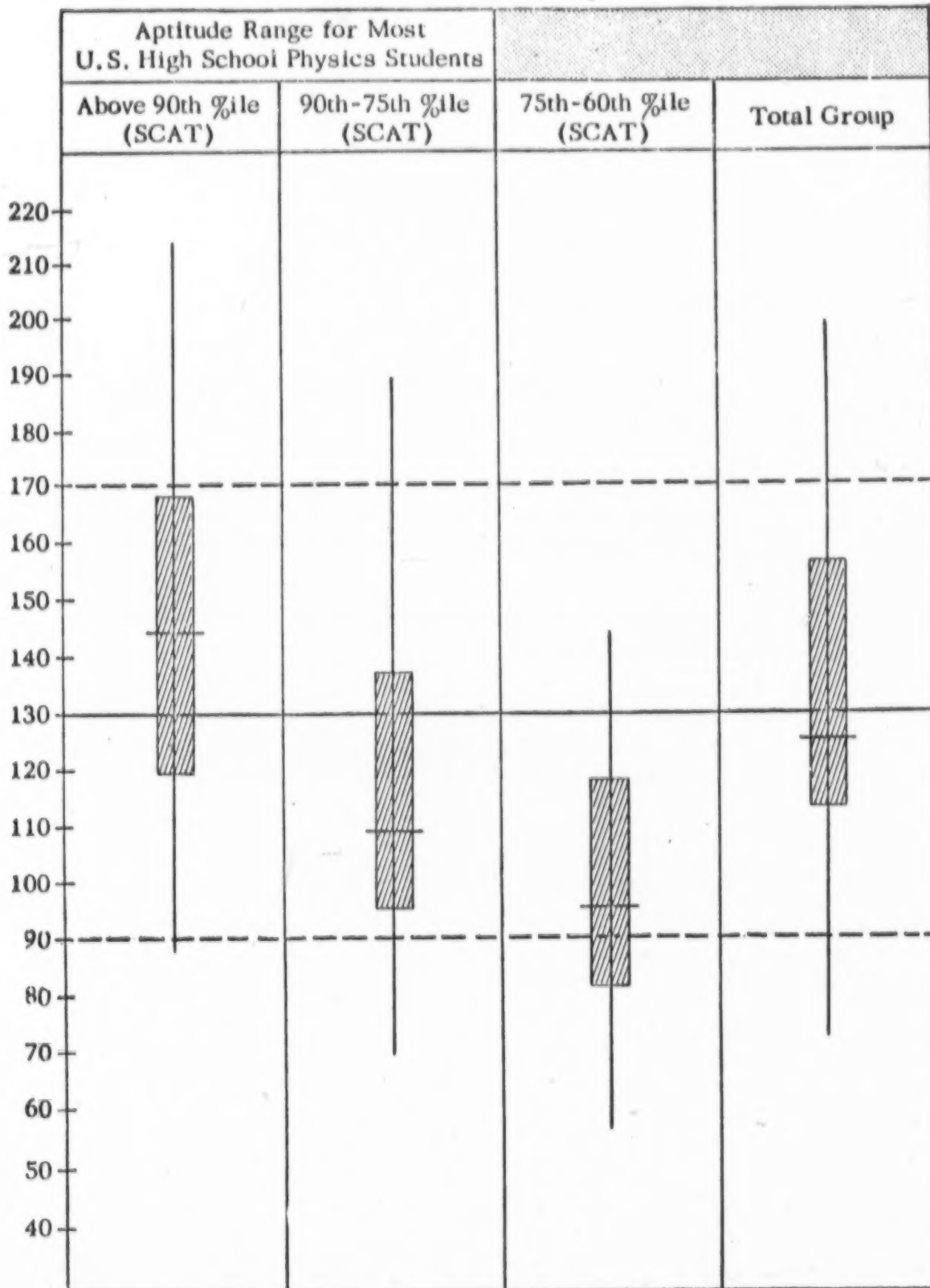


Table 4

PSSC ACHIEVEMENT TEST SCORES BY APTITUDE GROUPS

Test on Volume I (Chapters 7 - 10)

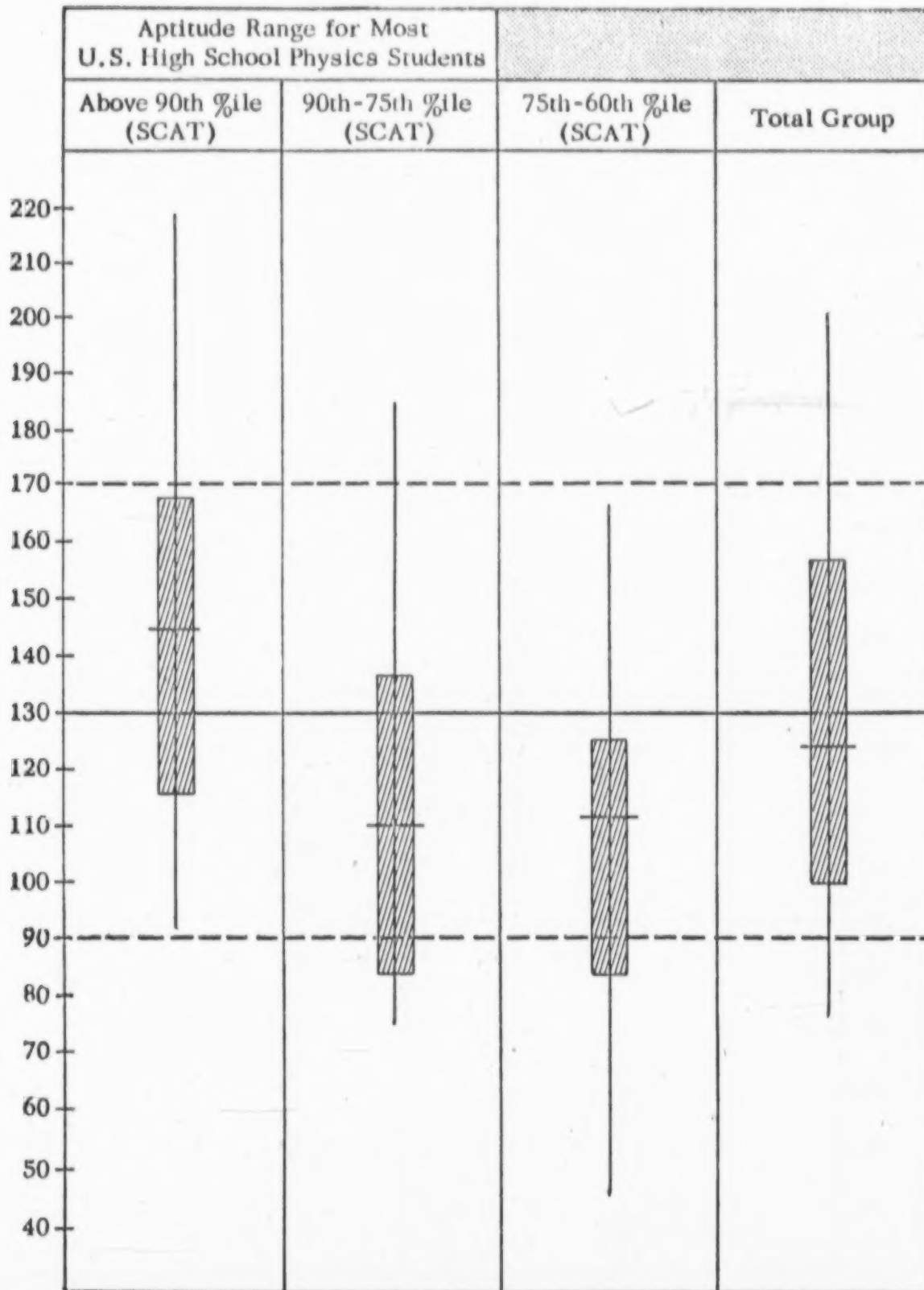


Table 5

PSSC ACHIEVEMENT TEST SCORES BY APTITUDE GROUPS

Test on Volume II (Chapters 1 - 5)

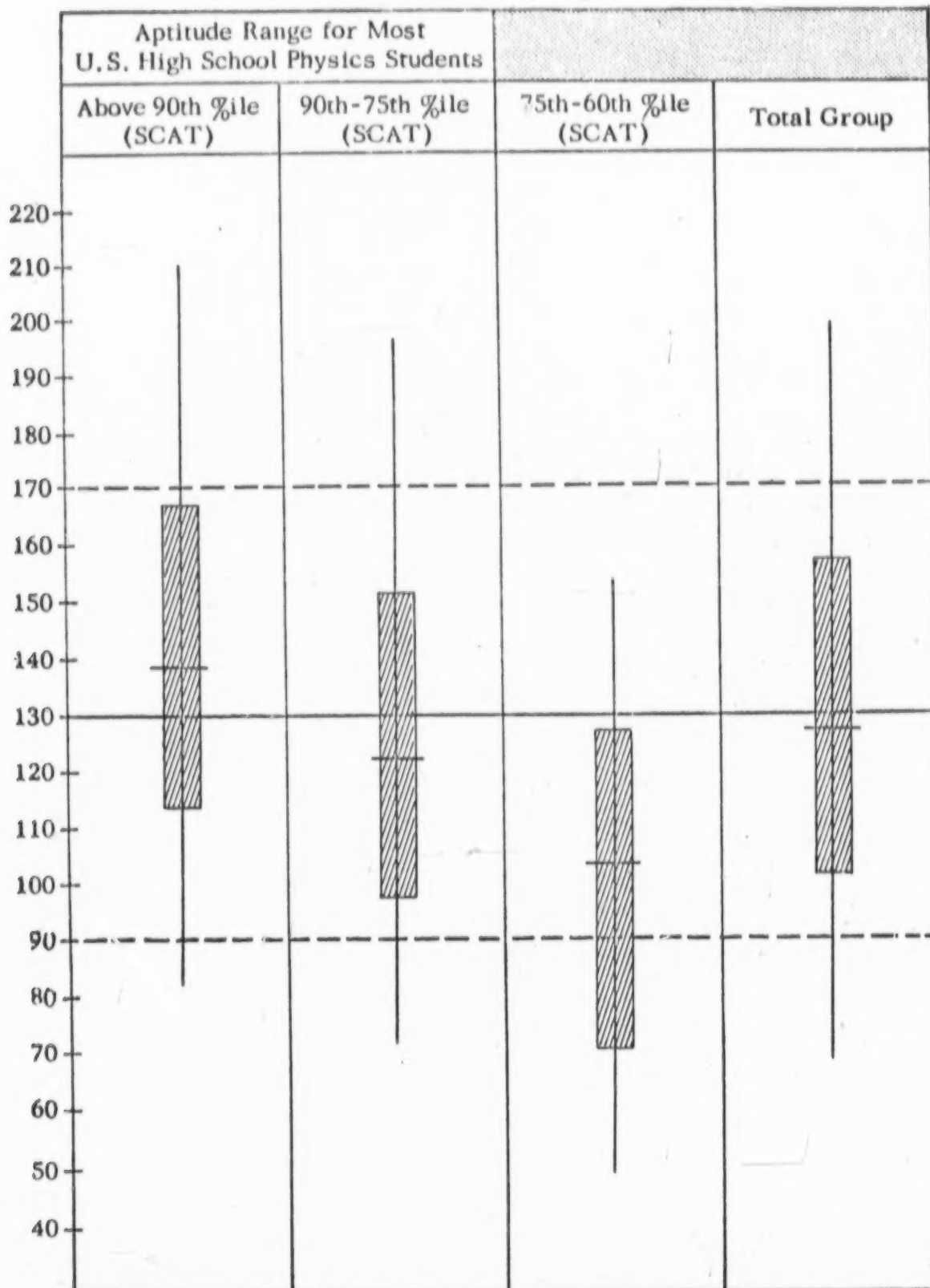
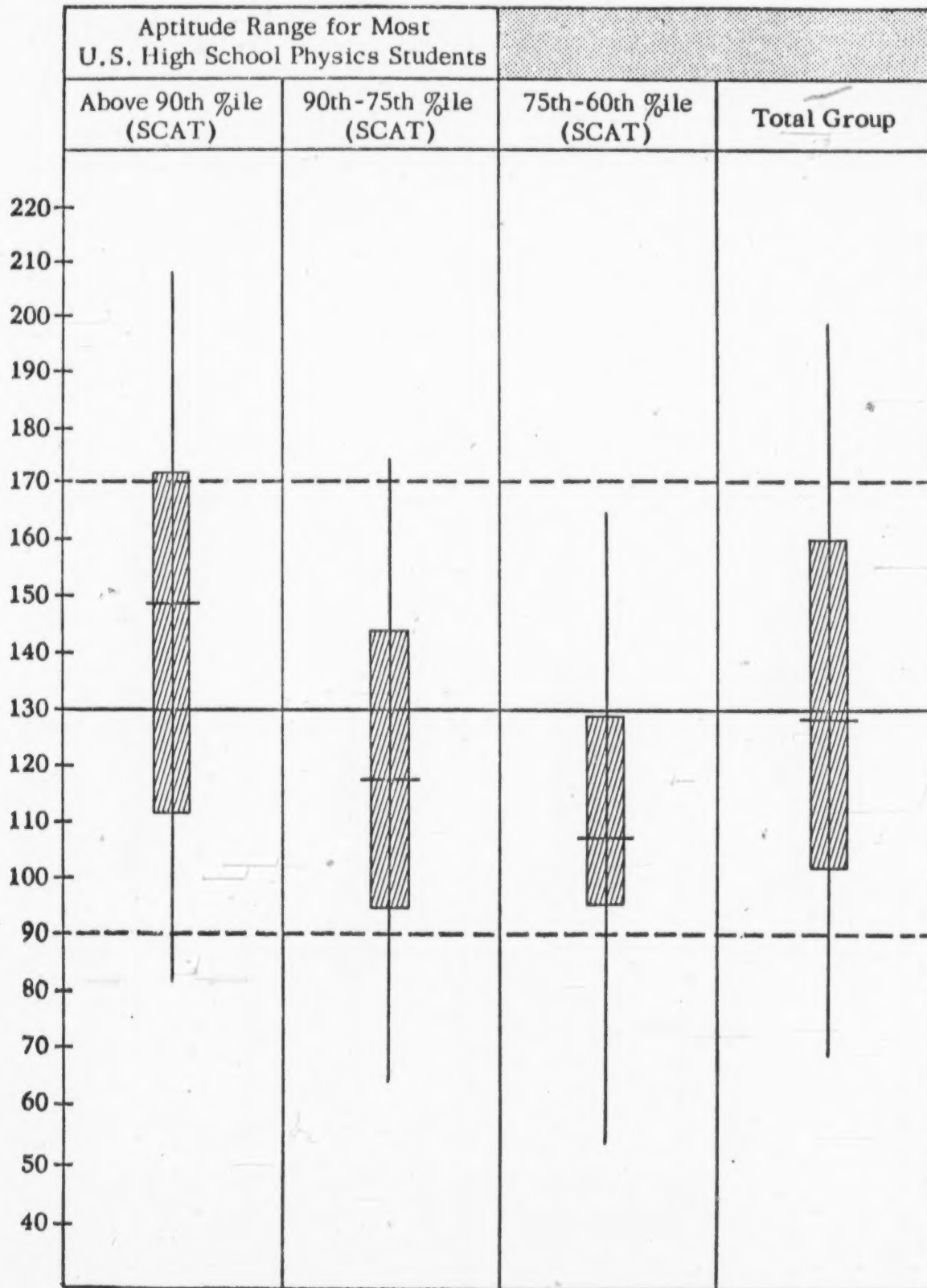


Table 6

PSSC ACHIEVEMENT TEST SCORES BY APTITUDE GROUPS

Test on Volume II (Chapters 6 - 9)



1950

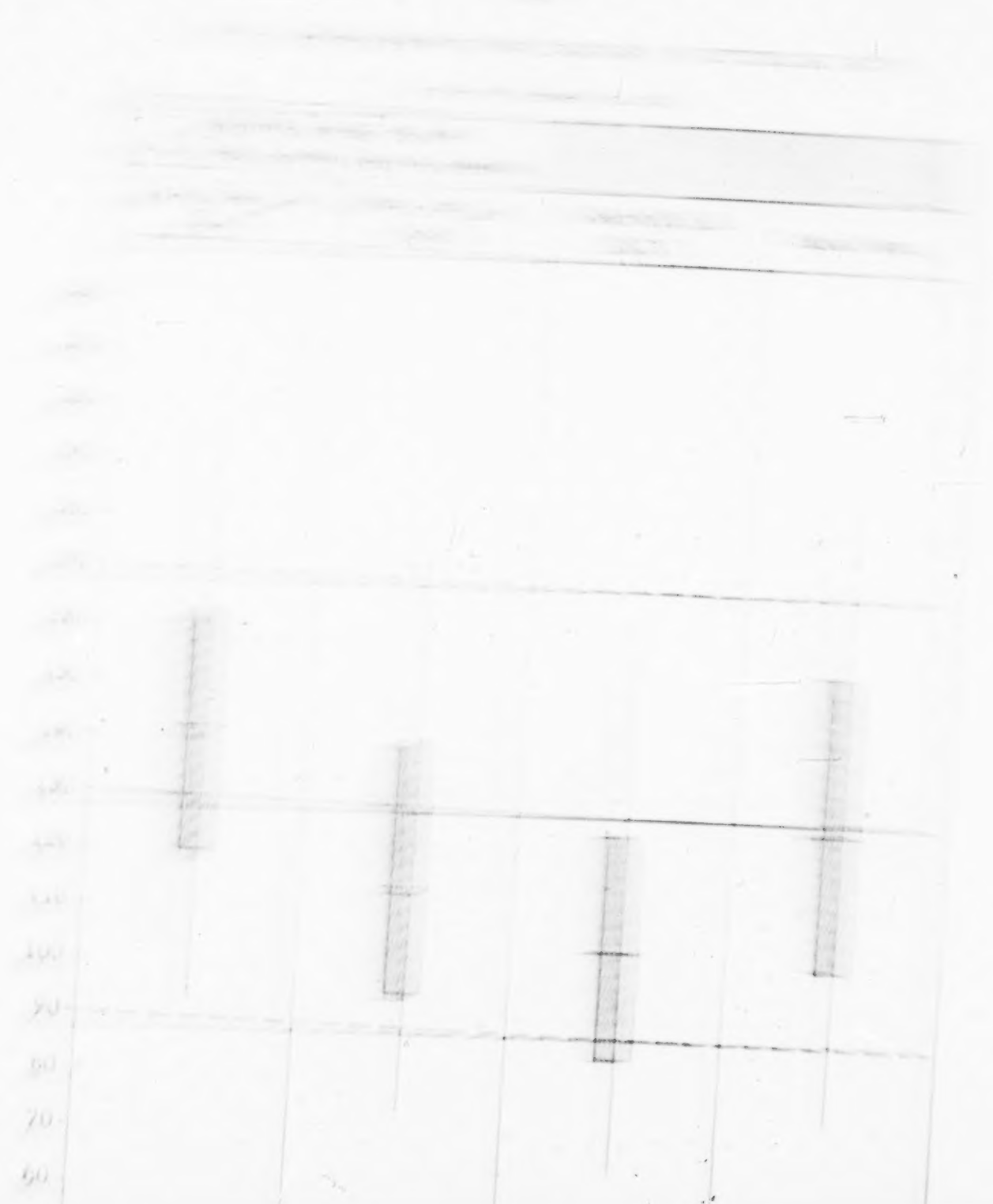


Table 8

PSSC ACHIEVEMENT TEST SCORES BY APTITUDE GROUPS

Test on Volume III (Chapters 1 - 4)

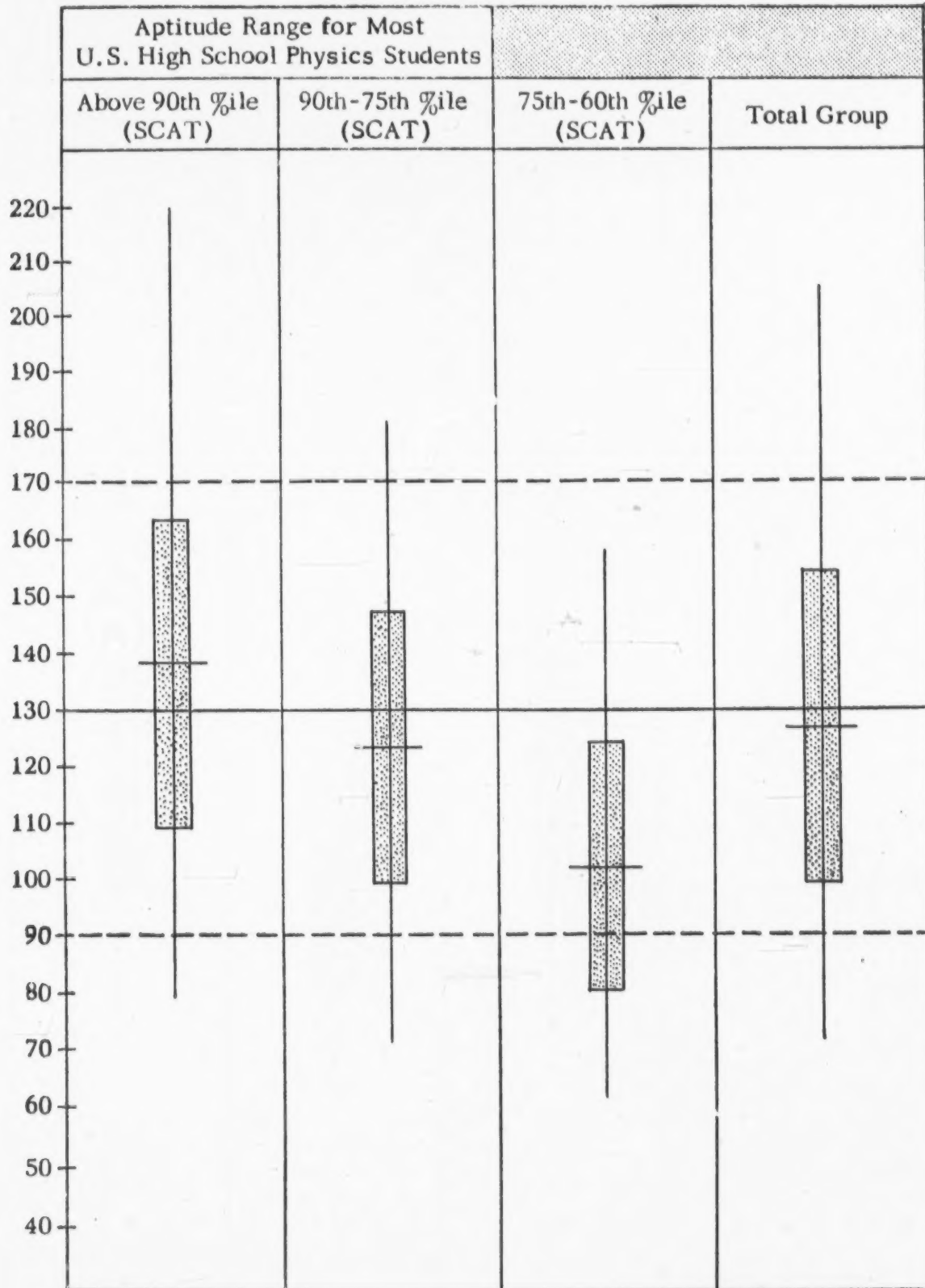


Table 9

PSSC ACHIEVEMENT TEST SCORES BY APTITUDE GROUPS

Test on Volume III (Chapters 5 - 7)

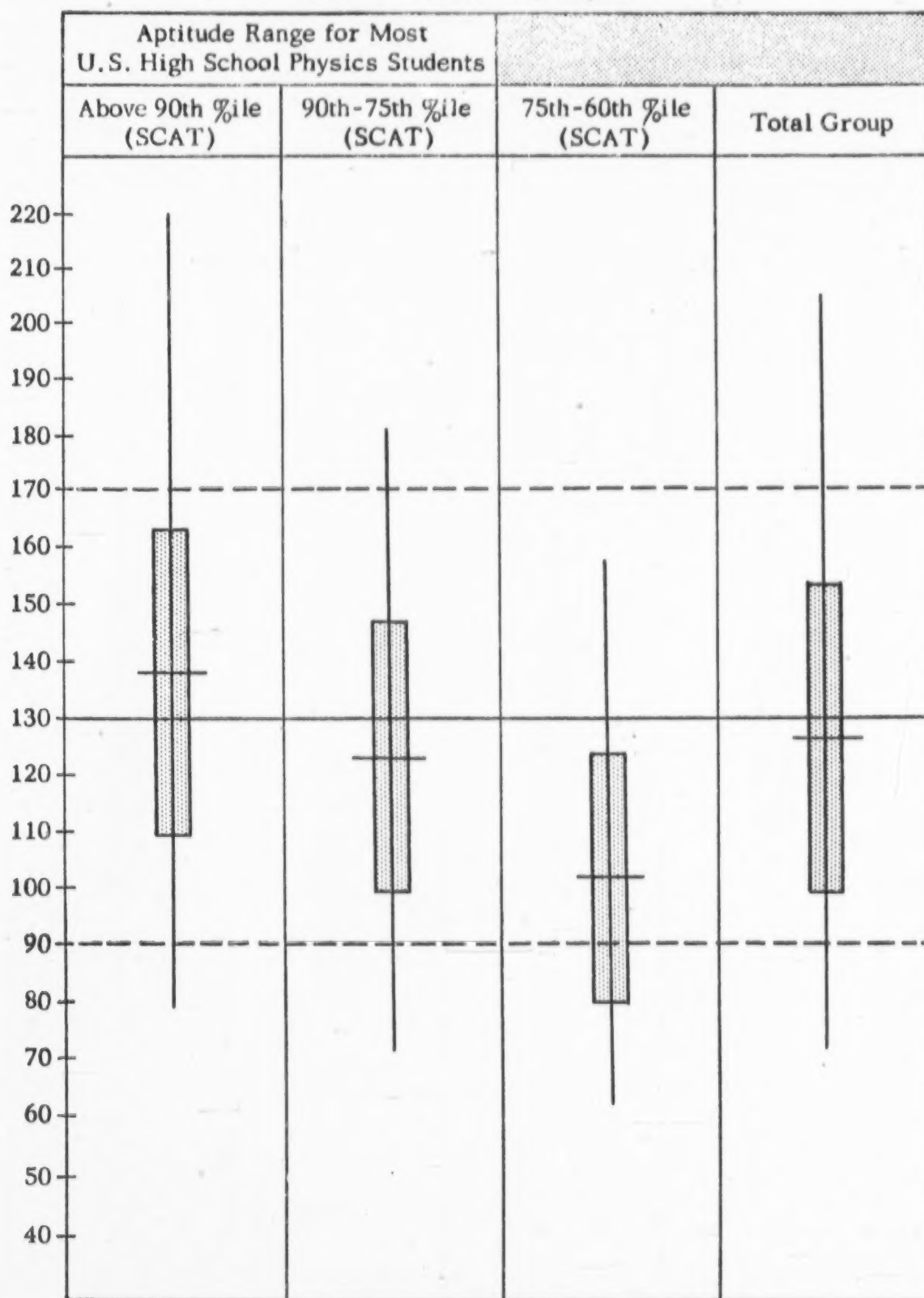


Table 10

PSSC ACHIEVEMENT TEST SCORES BY APTITUDE GROUPS

Test on Volume IV (Chapters 1 - 5)

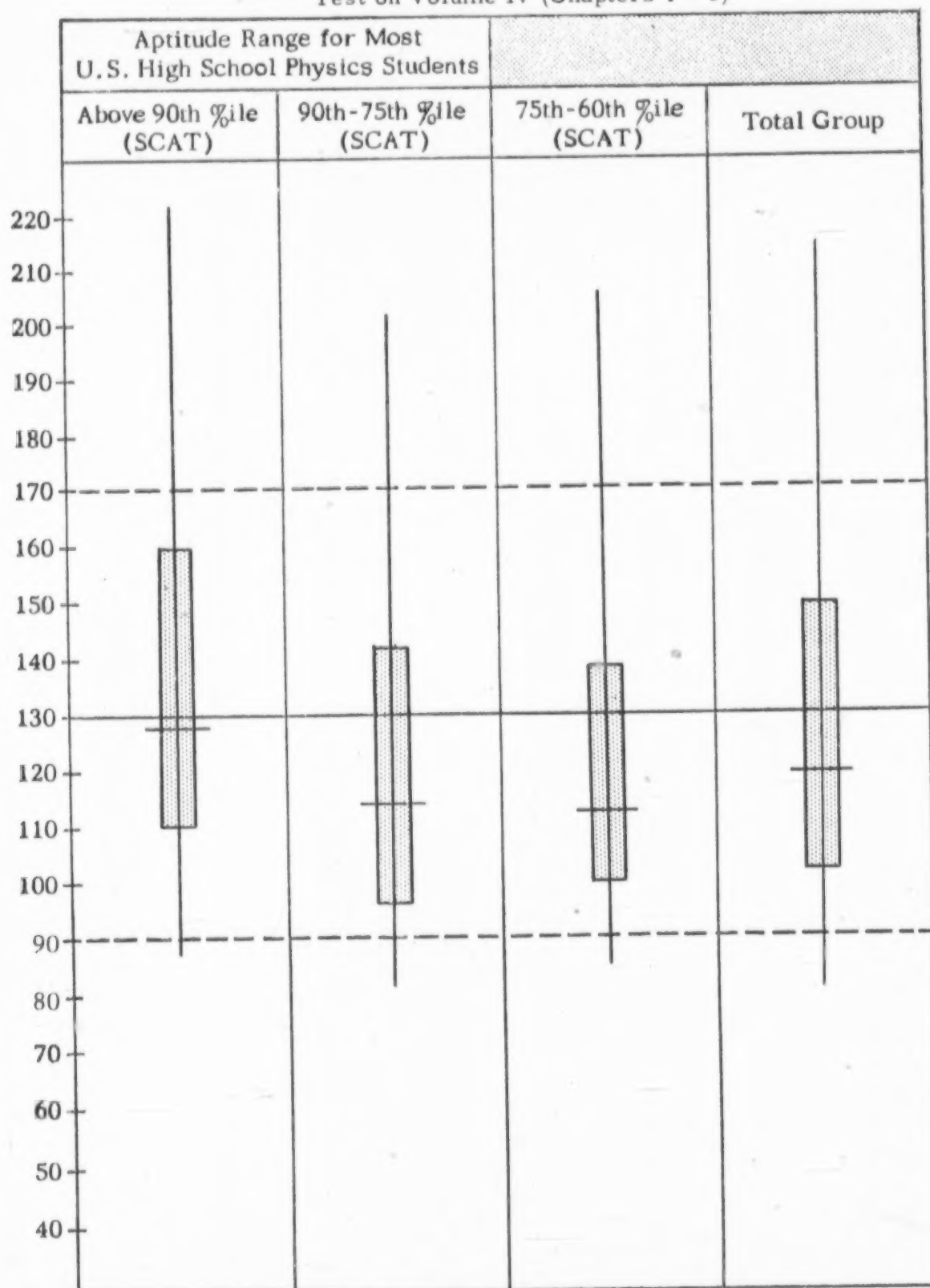
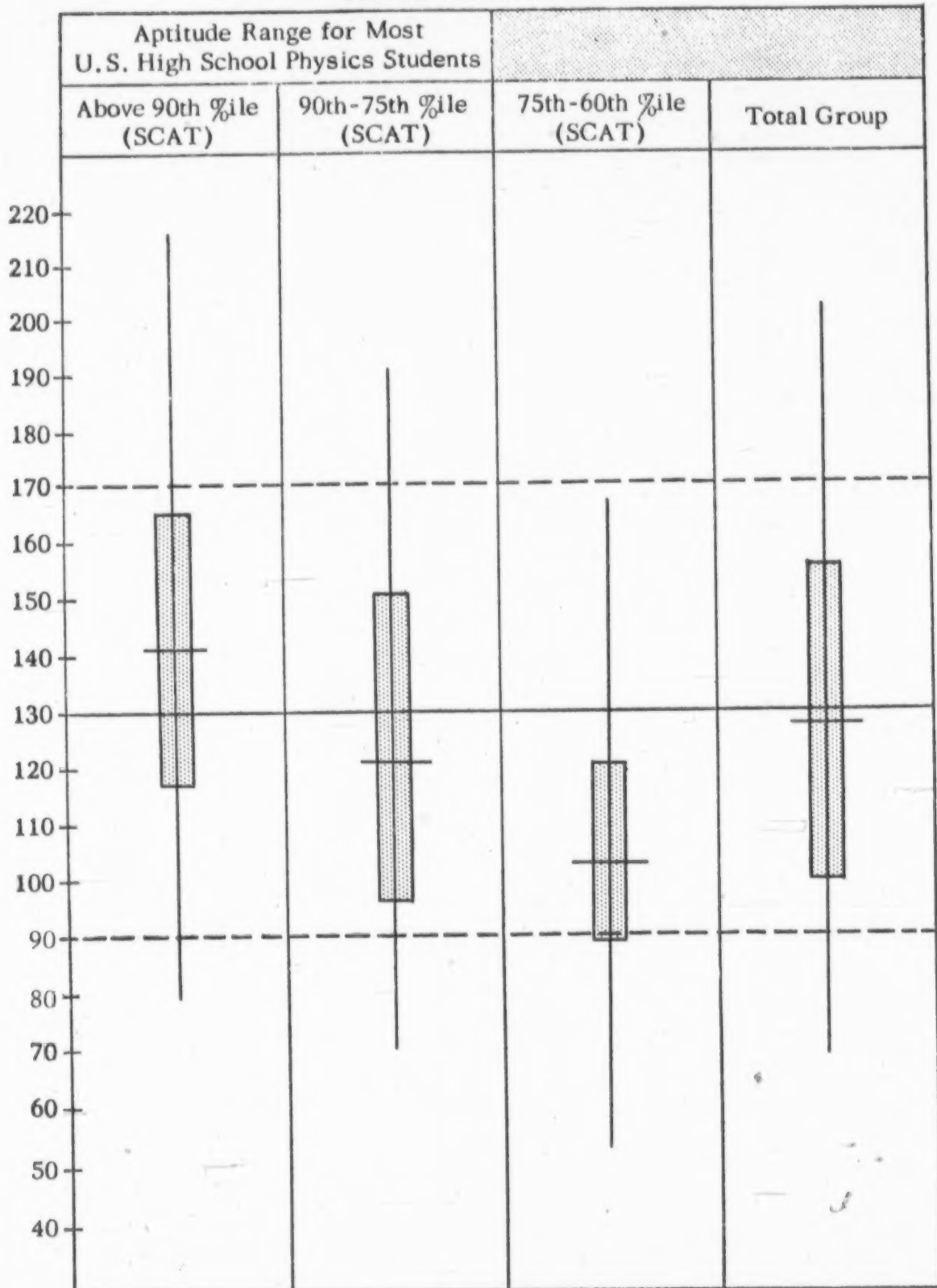


Table 11

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Test on Volumes III and IV



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